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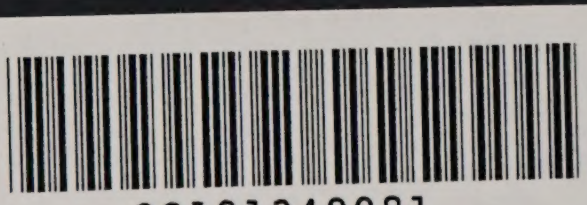
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A SYSTEM

OF

PRACTICAL THERAPEUTICS.

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VOL. III.—PART II.

WITH ILLUSTRATIONS.

EDINBURGH & LONDON:

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DISEASES OF THE VULVA AND VAGINA (NON-VENEREAL); LEUCORRHŒA.

By T. J. WATKINS, M. D.

DISEASES OF THE VULVA.

Vulvitis.

Vulvitis may be catarrhal, follicular, phlegmonous, gangrenous, aphthous, erysipelatous, or diphtheritic. It may result from uncleanliness of person or environment; from decomposed or diabetic urine; from irritating menstrual or leucorrhœal discharges; from ascarides; from traumatism, which includes excessive or violent venery, onanism, and the itching, scratching, and rubbing occasioned by pruritus; and from specific fevers. Obesity and the strumous diathesis predispose to vulvitis.

Catarrhal vulvitis involves the superficial epithelium, but may extend into the vulvar and vulvo-vaginal glands, the urethra and urethral glands, or into the vulvar connective tissue.

Follicular vulvitis involves the sebaceous and sudoriparous, rarely the mucous, glands.

Phlegmonous vulvitis is an inflammation of the connective tissue, is usually associated with other varieties of vulvitis, and frequently results in abscesses and furuncles.

Gangrenous, aphthous, erysipelatous, and *diphtheritic vulvitis* present the same general characteristics as when these varieties of inflammation occur in other parts of the body.

When the variety of vulvitis has been determined, its etiology ascertained, and its pathological lesions recognized, the treatment will usually be very satisfactory.

The patient should remain quiet; in severe cases the recumbent posture should be maintained. The ice-bag is a valuable agent in the early stage of acute vulvitis. It relieves the congestion and œdema, and is very grateful to the patient. It should not, however, be used continuously, as it may produce necrosis. In the later stages of the disease hot moist applications should be used for the relief of these

conditions. They are most conveniently and satisfactorily applied by means of poultices.

The vulva should be kept as free as possible from all secretions and discharges by vaginal douches, irrigations, and baths. The douches and baths should be rendered antiseptic by the use of carbolic acid, 1 to 2 per cent.; bichloride of mercury, from 1 : 1000 to 1 : 4000; boric acid, 2 to 5 per cent.; creolin, from 1 : 200 to 1 : 500; or Thiersch's solution. Carbolic acid is preferable when burning and itching exist. The use of bichloride of mercury should not be so prolonged as to destroy the epithelium. In severe cases the antiseptic solutions may be employed frequently or continuously for a short time, but in mild cases ablutions twice daily will be sufficient.

Ointments should be employed when necessary to protect the vulva from irritating discharges and to keep its surface moist. Zinc ointment, vaseline, cold cream, or benzoated lard may be used for this purpose. I have found a mixture of $\frac{1}{2}$ drachm to 1 drachm of beeswax to the ounce of zinc ointment very satisfactory. The beeswax must be well heated in order that it may mix thoroughly with the zinc ointment.

The vulva may be absolutely protected from urine by the use of a perineal shield which I have devised (see Fig. 4), and which was described in the *American Journal of Obstetrics*, April, 1891, p. 501.

Fig. 4.

During the acute stage of vulvitis in children they should be placed in a warm bath to urinate. A small piece of lint or gauze should be placed between the labia to prevent friction.

The general condition of the patient should always be carefully studied and treated according to indications.

Catarrhal Vulvitis.—Nitrate of silver is the most valuable agent in the treatment of this inflammation. It usually relieves the burning and itching which are the most distressing symptoms. It should be employed as follows: Apply a 10 per cent. solution of cocaine to the

inflamed surface, followed five or ten minutes later by a solution of 20 to 60 grains of nitrate of silver to the ounce of water. This should now be covered by a thick layer of vaseline or by a flaxseed poultice. A single application of the nitrate-of-silver solution will usually be sufficient in mild cases of catarrhal vulvitis, but in severe cases repeated applications at intervals of three or four days will be necessary. If, notwithstanding this treatment, the pain continue severe, sedatives should be employed. When the vulva is moist the following is an excellent sedative:

℞. Tincturæ opii,
Liquor. plumbi subacet. dil., āā. f ℥j;
Aquæ, f ℥vj.—M.

The vulva may be kept moist by lint saturated with this solution. When the secretions are excessive and the pain not severe, a powder composed of equal parts of subnitrate of bismuth, starch, and chalk is very efficient. Each application of this powder should be preceded by a thorough irrigation with an astringent solution, such as sulphate of zinc, 1 to 5 per cent.; sulphate of copper, ½ to 1 per cent.; or bichloride of mercury, 1 : 2000 to 1 : 4000. If the discharge be purulent, a powder of equal parts of iodoform and subnitrate of bismuth will act well.

When the inflamed vulva is dry, ointments, such as oxide of zinc, vaseline (Chesebrough's), cold cream, or benzoated lard, should be used; and when indicated such sedatives and antiseptics as carbolic acid, acetate of lead, iodoform, and cocaine may be employed. I have found the following combinations useful:

℞. Acidi carbolici, ♏x–♏xv;
Liquoris plumbi subacetatis, f ℥j;
Vaselini (Chesebrough's), f ℥j.—M.

This preparation is especially efficient when pruritus exists.

℞. Iodoformi, gr. xxv–gr. xl;
Cocainæ hydrochloratis, ℥ss;
Vaselini (Chesebrough's), ℥j.—M.

℞. Ichthyol., gr. x;
Vaselini, ℥j.—M.

To be used when extensive excoriation is present.

If the presence of the oxyuris vermicularis be suspected a plain enema should be given daily, followed by an infusion of quassia, 2

ounces to the pint, for three or four days. A lotion of carbolic acid, ½ of 1 per cent., should be kept continuously over the vulva for one or two days.

In the treatment of vulvitis during the post-menstrual period it should be remembered that the normal secretions of the vulva are diminished and that the muco-cutaneous surface has become thickened and its elasticity lessened.

In chronic catarrhal vulvitis the vulvar or vulvo-vaginal glands, the urethral glands, or the urethra are frequently if not always involved. The cure of these cases depends largely upon the removal of the diseased condition in the glands and in the urethra. Frequent or continuous applications of astringent antiseptics, such as balsam of Peru, pinus Canadensis, pyroligneous acid, or bichloride of mercury, 1 : 2000 or 1 : 4000, over the affected areas will often effect a cure. It may, however, be necessary to lay the ducts of these glands freely open, and either thoroughly cauterize or curette. As a caustic, fused nitrate of silver or the Paquelin or galvano-cautery will be found effective. If the glands of Bartholini are extensively involved, they should be excised and the resultant wound be permitted to heal by granulation.

Follicular Vulvitis.—The cure of follicular vulvitis often requires thorough and severe treatment. First, the exciting cause should be removed, and then the glands should be relieved of their pent-up secretions by means of the curette, or in aggravated cases by the cautery. I have found nitrate of silver, 40 to 60 grains to the ounce, most serviceable as a caustic; it also destroys the diseased glandular tissue. It may be necessary to repeat this treatment two or three times at intervals of three or four days. When follicular vulvitis exists during pregnancy, palliation may be the only treatment which it is advisable to employ until the end of labor. The palliative measures are the same as those recommended in the consideration of catarrhal vulvitis.

Phlegmonous Vulvitis.—The treatment of phlegmonous vulvitis will depend to a great degree upon the nature and extent of the vulvar cellulitis. The inflammation may vary in intensity from a simple furuncle which requires little attention, to an active inflammation of the entire cellular tissue which demands active treatment. In the acute stage it is best treated with cold applications by means of the ice-bag, which should not, however, be continued too long for fear that it may produce necrosis. If the inflammation is not aborted by this treatment, hot applications should be continuously made. I have found flaxseed poultices made with 1 : 1000 bichloride-of-mercury solution very efficient in limiting inflammation and hastening suppuration. As soon as the presence of pus can be detected it

should be evacuated by a free incision, and the cavity drained by means of light packing with antiseptic gauze. The dressing should be changed when soiled and the wound irrigated if necessary.

Gangrenous Vulvitis.—Gangrene of the vulva is produced by the same causes and should receive the same treatment as gangrene in other parts of the body.

Aphthous Vulvitis occurs usually during childhood, and is characterized by whitish patches similar to those which exist in aphthous stomatitis. The patches are, as a rule, situated on the inner side of the labia. The treatment consists in the thorough local use of parasiticides, such as bichloride of mercury or carbolic, boric, or salicylic acid, which are always effective. I have found the following mixture efficient for the removal of aphthæ:

℞. Acidi salicylici, gr. x–xxx;
Bismuthi subnitratis, ʒij;
Glycerini, q. s. ad fʒj.—M.

The diseased area should be kept covered with this paste until the patches disappear. Lawson Tait says, "A lotion containing sodium hyposulphite is an unfailing remedy."[1]

Erysipelatous Vulvitis.—Erysipelas of the vulva usually occurs during childhood, and frequently soon after birth. It may result from infection of a wound, contusion, or abrasion of the vulva, or erysipelas may extend from other parts of the body to the vulva. The treatment should be both local and systemic. Tincture of the chloride of iron is probably the best local remedy: it limits the extension, lessens the virulence, and shortens the duration of the disease. Thorough local applications should be frequently made to the affected portion of the vulva, and should be continued throughout the actual stage of the disease. Good results may also be obtained by the use of ointment of ichthyol, 10 per cent.; ointment of carbolic acid, 2 to 5 per cent.; or by a lotion of bichloride of mercury, 1 : 2000. Cold applications are almost always grateful to the patient. The usual systemic remedies should be given, including the free use of dialyzed iron or the tincture of the chloride of iron.

Diphtheritic Vulvitis is usually a disease of childhood, but it may result from infection of puerperal or other wounds of the vulva, or may exist as a complication of diphtheria in other parts of the body. Local treatment alone is necessary in the early stage of the disease when uncomplicated. I consider the disease primarily local, and when, seen early, easily cured by destroying the specific poison and dissolving the diphtheritic membrane. Salicylic acid perfectly fulfils these indications.

[1] *Diseases of Women and Abdominal Surgery*, vol. i. p. 13.

I invariably use the following preparation for diphtheria, and have never known it to fail:

℞. Acidi salicylici,		ʒss–j ;
Bismuthi subnitratis,		ʒij ;
Glycerini,	q. s. ad	fʒj.—M.

Frequent and thorough applications should be made as long as any diphtheritic exudate exists. Its use, however, should not be prolonged beyond this point. After the disappearance of the exudate mild astringent antiseptic applications are indicated. Coexisting complications should be treated according to the indications.

Eruptive Diseases of the Vulva.

Eczema.—Eczema of the vulva may be either primary or secondary. The former alone will be considered here. The eruption may be erythematous, papular, pustular, vesicular, or squamous. Vulvar eczema occurs most frequently at the menopause, during pregnancy, or at the menstrual molimen. Tait[1] considers diabetic urine the most common cause of the disease at the menopause. Irritating discharges from the bladder, vagina, uterus, or Fallopian tubes or from pelvic abscess may produce eczema of the vulva. The surface of the vulva may be inflamed, dry, œdematous, and thickened by exudate, may be covered by scales and crusts, or may be excoriated and suppurating. In this disease the vulva is usually bathed with the vaginal discharges.

The treatment consists in the removal of the cause if possible, and in the employment of measures for the repair of the lesion. The urine should be frequently examined for sugar, and should be kept from contact with the diseased area by means of the perineal shield (see Fig. 4), by instructing the patient to urinate while in the bath, or by irrigating the vulva after urination. Tait[2] highly recommends douches of hyposulphite of sodium, 1 ounce to the quart, to prevent fermentation of the urine. When eczema occurs during menstruation the uterus or Fallopian tubes may be diseased, and should be treated according to indications. The topical treatment of the lesion should be the same as when the eruption occurs on other portions of the body.

Herpes.—Herpes zoster is probably the only herpetic eruption of the vulva. The disease is usually limited to one side. The labium minus is the part most frequently affected. The eruption is characterized by vesicles containing clear serum, and usually appears in groups of vesicles along the course of the superficial nerves. These nerves are, as a rule, very sensitive to pressure. Herpes may result from

[1] *Op. cit.*, p. 14.

[2] *Op. cit.*, p. 15.

trauma or from systemic disturbances. The eruption is aggravated by friction. The pain along the course of the affected nerve is often intense.

During the acute stage of the disease the patient should remain quiet and the labia should be kept separated by lint, cotton, or gauze. Hypodermic injections of morphine at the seat of pain will give relief which may be permanent. The pain may also be relieved by local sedatives, such as menthol, 30 grains to the ounce; carbolic acid, 1 to 2 per cent.; and the lead-and-opium wash. Painting the affected areas with equal parts of the tinctures of aconite, belladonna, and iodine may control the pain. Very hot or very cold applications may be grateful to the patient. When the eruption is not painful the vesicles may be quickly dried by dusting them with powdered oxide of zinc. Should any constitutional disturbances exist, they should be treated according to indications.

Prurigo of the vulva rarely occurs. The eruption is characterized by small reddish and slightly-elevated papules. Kühn describes a dark, reddish, gland-like, tenacious depression in the centre of the papule. According to Klebs,[1] the papules contain dilated lymphatics, which press upon the nerves and cause pain and itching. Almost all the writers upon prurigo claim that it is incurable, but Kühn[2] states that the disease disappears soon after the removal of the dark spot which he describes. The usual measures should be employed for the relief of the pain and pruritus.

Parasitic Diseases of the Vulva.

Scabies of the vulva results from infection by the Acarus scabiei. The lesion is characterized by whitish furrows underneath the epidermis. When uninjured these furrows contain serous fluid in which the presence of the parasite may be detected by the microscope. The character of the lesion is much changed by the scratching and rubbing to which the patient resorts for the relief of the characteristic intolerable itching.

In the treatment of scabies of the vulva the affected area should be thoroughly washed with a weak solution of bicarbonate of sodium, and the vulvar hair removed if necessary. The following prescription will be found efficient:

℞. Sulphur. sublimati, ℥j;
Sodii bicarbonat., ℥j;
Vaselini (Chesebrough), ℥ij.—M.
Sig. Use freely after bathing.

[1] Winckel, *Handbook of Diseases of Women*, p. 57.

[2] *Ibid.*

The local use of balsam of Peru is certain to destroy the parasite, but it leaves an indelible stain on the clothing.

Pediculus Pubis.—This parasite may infest the vulva. It produces intense pruritus, and the attempt to relieve this by scratching and rubbing may result in extensive erosions or in acute vulvitis. The parasite may be destroyed by the local use of mercurials and other parasiticides, such as mercurial ointment, 5 per cent. carbolic-acid solution, or sulphur ointment. In severe cases the hair on the pubes and vulva should be shaven.

Tumors of the Vulva.

Cystoma.—Cystic tumors of the vulva may develop in the vulvo-vaginal glands or in their ducts, in the mucous glands, and in the lymphatic spaces (Klebs).[1] The disease most commonly occurs in the Bartholinian glands and their ducts. When the gland is affected the tumor may be lobulated. The contents of the cyst may be watery, viscid, sanguineous, or purulent. If the tumor be large it should be freely incised, its lining membrane thoroughly curetted and painted with a strong solution of carbolic acid, iodine, or nitrate of silver, and the cavity packed with gauze. The dressing should be changed when soiled. Small cysts of the Bartholinian glands should be entirely removed if they cause any disturbance. Cysts may occur in Gärtner's canal. They are usually small, and are filled with a clear serous fluid. Incision of the tumor and cauterization of its lining membrane will often effect a cure. Cysts of the mucous glands or follicles are usually small and contain a thick mucous substance. They are cured by simple evacuation.

Hydrocele is a collection of serum about the round ligaments; that is, in the canal of Nuck. The serum may be mixed with pus or blood. Care must be exercised in differentiating between this affection and hernia. When the tumor is small it may be removed by the use of counter-irritants, such as tincture of iodine, croton oil, and cantharides. Aspiration may be necessary to remove the fluid. For this purpose a hypodermic syringe may be used. The needle should be allowed to remain *in situ*, and through it should be injected a few drops of compound tincture of iodine or of 95 per cent. carbolic acid, which by setting up an active inflammation will usually obliterate the sac. In severe cases it may be necessary to incise the sac of the hydrocele and force the cavity to close by granulations. This should be done as follows: The field of operation should be shaved and thoroughly cleansed. The tumor should then be incised throughout its entire length, and the lining of the cavity destroyed by curettement, caustics, or the cautery. The cavity should now be packed with antiseptic gauze. Irrigation

[1] *Handbuch*, i, 2, a. 965.

with antiseptic fluids should be employed when necessary for surgical cleanliness, and the dressing changed when soiled.

Hernia.—Vulvar hernia may be either inguino-labial or vagino-labial. In inguino-labial hernia some of the abdominal or pelvic viscera escape along the round ligament into the labium. Cases are on record in which the hernial sac contained omentum, intestines, Fallopian tube, ovary, or even the uterus. Vagino-labial hernia is a protrusion of some of the viscera through the broad ligament and the levator ani muscle into the labium.

The treatment of the inguinal variety may be either palliative or curative. The palliative treatment consists in replacing the hernia and in retaining it in place by means of a truss. The curative treatment is the ordinary radical operation for hernia. The vaginal variety of hernia should be treated by replacing the dislocated viscus, and by retaining it in place by means of a ring pessary or Scarpa's pad. It may be possible, however, to suture the opening in the levator ani after the reduction of the hernia.

Varicocele.—The veins of the vulva may become varicosed, as do veins in other parts of the body. As a rule, the superficial veins alone are affected, but Tait[1] reports a case in which the veins were so extensively involved as to produce a large tumor in each labium. Varicocele of the vulva may result from inflammation of the inner coat of the veins, from obstruction by pressure, from straining at stool, lifting, etc., and may be either unilateral or bilateral. The tumor most frequently occurs in women who have borne children. It may cause œdema, a burning sensation, or pruritus. It may be so large as partially to occlude the vaginal canal and to obstruct labor. The danger of rupture of varicose veins during labor should always be borne in mind.

Varicocele due to pregnancy may be relieved by pressure. When the disease is confined to the superficial veins, they may be incised and their contents evacuated, or they may be dissected out. Should the veins affected be large and numerous, the diseased portions may be ligated and excised.

Hæmatoma of the vulva is an accumulation of blood in the connective tissue of the labium from a ruptured vessel. The tumor may be small or may distend the entire labium. The predisposing causes are varicocele and pregnancy. The chief exciting causes are injuries, such as kicks, blows, instrumental delivery, etc., and over-distension of veins due to labor, straining at stool, heavy lifting, and the like. If the tumor be small it may disappear by absorption. A large accumulation of blood may cause sloughing or may suppurate.

During the early stage of the disease the hæmorrhage may be

[1] *Op. cit.*, p. 41.

checked or limited by keeping the patient recumbent and by the local use of ice. Hot applications should be employed to promote absorption. Should the tumor threaten to produce sloughing or to suppurate, it must be opened by a free incision. If bleeding vessels exist, they should be ligated and the cavity thoroughly cleansed. The wound may be entirely or partially closed by sutures and the usual antiseptic dressings applied.

Condyloma.—A condyloma consists of a framework of connective tissue which contains blood-vessels and probably nerves and lymphatics, and which is covered by a thick layer of epithelium. Condylomata are, as a rule, hypertrophied papillæ, but they occasionally occur upon surfaces which contain no papillæ. They are most commonly located upon the nymphæ, fourchette, and around the anus, but may extend into the vagina and even over the cervix uteri. They occur frequently in young women and during gestation, at which time the papillæ are active. Condylomata may be pointed or broad; they may be few and scattered or numerous and apparently confluent; but on careful examination each tumor will be found to be attached by a small pedicle. They may vary in size from a slight enlargement of a papilla to a large projecting mass. They may be dry or moist, but are usually covered by a profuse secretion. Ulceration frequently occurs on account of the friction and acrid discharge. Condylomata frequently appear to be dependent on the leucorrhœal secretion for their growth, and occasionally even for their existence.

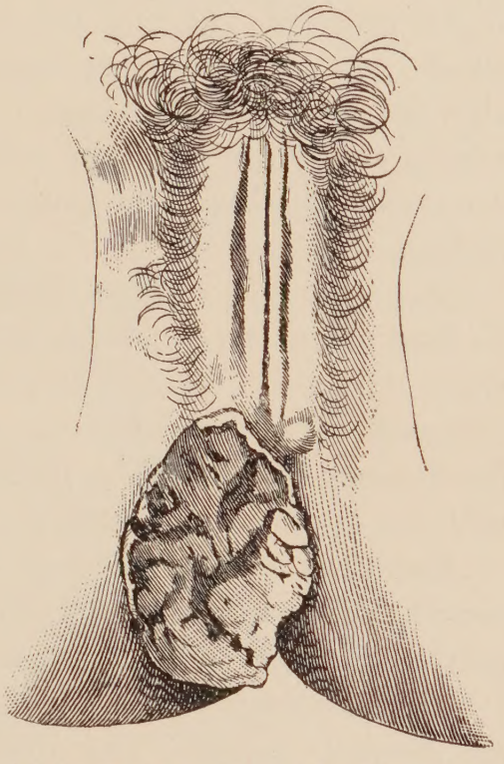
The treatment consists in the removal of the cause if possible, and in the eradication of the tumor. Great care should be taken to keep the growths free from secretions and discharges, as otherwise it is difficult or impossible to effect a cure. Frequent and thorough bathing of the vulva with cold water may of itself cause the disappearance of the growths. Should there be a leucorrhœal discharge, the ordinary antiseptic douches should be systematically employed. In case of moist growths, dryness should be secured by the free local use of calomel either alone or in combination with iodoform, subnitrate of bismuth, starch, or chalk. I have observed very good results from the use of equal parts of calomel and aristol. When the condylomata are dry, good results may follow the local use of mercurial ointments.

Large condylomata may be removed by ligation of their pedicles and excision of the growths. Their bases should then be destroyed by caustics or the cautery. For the former, fused nitrate of silver, osmic acid crystals, chloride-of-zinc paste, or carbolic acid may be employed. Chloride-of-zinc paste is probably the best caustic, as it acts upon the diseased tissues only. It may be prepared by mixing together the officinal solution of chloride of zinc and wheat flour. Cauterization may be produced by the use of the galvano-cautery, Paquelin cautery,

or a pointed steel instrument brought to a red heat. Small condylomata may be eradicated by the use of caustics, the cautery, or the curette. Should hæmorrhage persist after the removal of the tumor, it may be necessary to pass a suture so that it will include the bleeding point. Internal remedies should be given according to indications.

Lupus is characterized by confluent nodules. The first manifestation of the disease is the appearance of small papules, which gradually enlarge, soften in the centre, ulcerate, and finally cicatrize. The cicatrices may be quite deep. All the different stages of the disease may be seen at the same time. Three varieties of lupus of the vulva have been described—serpiginous, perforating, and hypertrophic. Martineau[1] considers the disease tubercular, and recent investigation has demonstrated the presence of giant and lymphoid cells and the bacillus tuberculosis. Some authors assert, and others deny, that the adjacent glands are affected. In two cases which I have observed these glands were not affected. The labium majus is usually the seat of the disease, but it may extend to the labium minus. Lupus of the vulva is a rare disease. Winckel states that not more than twenty-five cases have been reported.

FIG. 5.



Lupus Hypertrophicus (after Huguier).

As a rule, the patient suffers only from the inconvenience and irritation of the growth. In one case which I observed, however, there was severe local pain. The tumor may be excised, cauterized, or curetted. The excision wound should if possible be closed, as a granulating surface is a good nidus for the disease. The Paquelin is probably the most efficient cautery. The best caustic is in my opinion the chloride-of-zinc paste described in the treatment of condylomata. After using the curette the resultant wound should be thoroughly cauterized. If granulating surfaces remain, antiseptic dressings are indicated. The reports thus far of the treatment of lupus by Koch's tuberculin would seem to justify at least a trial of this remedy. The treatment of lupus of the vulva is usually satisfactory for a time, but the marked tendency of the disease to recur should be borne in mind.

Carcinoma.—Under this heading will also be considered epithe-

[1] *Cyclopædia of Obstetrics and Gynæcology*, vol. xii. p. 278.

lioma. Carcinoma of the vulva is of relatively infrequent occurrence as compared with carcinoma of the uterus. The proportion is as 1 to 35 or 40. The disease most frequently commences on the inner surface of the labium majus near the fourchette. It usually extends along the labium, and frequently involves the clitoris, but extension to the vagina rarely occurs. The adjacent glands are affected early in the disease. The character of the growth is the same as that of carcinoma in other regions of the body. Up to the ulcerative stage the disease may develop unnoticed, and usually the only subjective symptom is slight pruritus. During the ulcerative stage the patient suffers pain, which may be very severe, and there is an acrid, fœtid, and occasionally sanguinolent discharge. It is said that death usually occurs within two years after the commencement of the ulcerative process. As a rule, death results from exhaustion, seldom if ever from hæmorrhage.

The treatment consists in the early removal of the tumor. If this be done before the glands become involved, the prognosis is quite favorable. Great care should be taken, however, that the tumor is entirely removed. Küstner[1] advocates the removal, as far as practicable, of all the diseased glands. The methods described for the excision of lupus will also apply to the removal of carcinoma.

Sarcoma seldom develops in the vulva. Very few cases are on record. The character of the tumor is the same as in sarcoma in other parts of the body. The treatment should be the same as for carcinoma.

Elephantiasis of the vulva is a rare disease, and especially rare in the United States. The disease most frequently affects the labia majora and clitoris, but may occur upon the nymphæ (Mayer).[2] The growth may vary in size from a slight thickening of the cutis to a tumor which may extend as far as the knees. Virchow[3] regards the disease as originating in the lymphatic glands and connective tissue, but Winckel[4] states that it is still a mooted question whether the deeper layers of the skin or the capillary lymph-vessels of the corium are first affected, or whether the lymph-stasis caused by the hyperplasia is produced by the pressure of the swollen glands upon the lymphatics.

Winckel[5] gives the following classification of elephantiasis based upon the external appearance:

a, Elephantiasis glabra (smooth).
b, Elephantiasis verrucosa (warty).
c, Elephantiasis papillomatosa (papillary).

[1] Winckel, p. 46.
[2] *Cyclopædia of Obstetrics and Gynæcology*, vol. xii. p. 292.
[3] Emmet, *Principles and Practice of Gynæcology*, p. 622.
[4] P. 33.
[5] *Op. cit.*, p. 34.

According to the consistence of the growth, he also describes elephantiasis dura and elephantiasis mollis.

Klebs[1] describes three varieties of the disease:

a, Elephantiasis lymphangiectomatica.

b, Elephantiasis epidermoidalis.

c, Elephantiasis of the connective tissue of the vulva.

The degree of hypertrophy usually varies in different parts of the skin in the same case, and so the tumor may be globular or lobulated. It frequently becomes pedunculated by reason of its weight. It usu-

FIG. 6.

Elephantiasis (after Zweifel).

ally grows rapidly, but much more rapidly after the pedicle has commenced to form. When the tumor involves only the epithelium it is called ichthyosis vulvæ. On section of the tumor it will be seen that the epidermis is thickened, the papillæ hypertrophied, and the cutis much thicker than normal. The connective tissue is also enormously increased, and the tumor will contain much serous fluid. Spindle cells and round cells containing many nuclei may be found in the tumor (Winckel).[2]

[1] Winckel, p. 34.

[2] *Op. cit.*, p. 35.

Little is known of the etiology of the disease. Syphilis is supposed to be the most common cause. Veh[1] has reported two cases, in one of which syphilitic infection could be proven; in the other scrofula was the only ascertainable cause. Mechanical irritation, including excessive venery, trauma, and climatic influences, may cause the disease. The tumor occurs most frequently between the ages of twenty and thirty years (Mayer).[2]

The symptoms of the disease are burning pains in the region of the tumor, dragging sensations from its weight, vulvitis and erosions, difficult or painful urination, and difficulty in walking. Ulceration or gangrene of the tumor may supervene. Klebs[3] reports a case of death from peritonitis in a lying-in woman who had elephantiasis.

The treatment consists in the extirpation of the growth. When the pedicle is small it may be clamped, transfixed, ligated, and the tumor removed with the knife or scissors. All bleeding points should be carefully ligated. After the removal of the tumor the wound should be partially or entirely closed by sutures. If the tumor is very hæmorrhagic, its base may be ligated in sections and the tumor removed in the following manner: A long straight needle armed with heavy silk is passed through the tumor about an inch from its edge and tied. The portion of the tumor included in the ligature is now incised. A second ligature may be carried from this point so as to include another portion of the tumor, and the included portion incised. This procedure is continued until the entire tumor is removed. Hæmorrhage from the incised portion of the tumor may be controlled by forci-pressure or by including the bleeding vessel in a ligature. The tumor may also be removed by the Paquelin or galvano-cautery. The wire loop of the latter is probably the best instrument for the removal of excessively hæmorrhagic growths. The growths seldom if ever recur.

Fibroma of the vulva is not frequently met with. Fibromata usually occur in the labia majora, but may develop in the perineum or even in the nymphæ. Kiwisch[4] states that fibromata may develop from the interstitial tissue of the labia majora, from the pelvic fascia, and from the periosteum of the pelvic bones. Klob states that they usually contain interstitial tissue and muscular fibres. Their size may vary from very small growths to tumors the size of a man's head. Zweifel has removed a fibroma the size of a child's head, and Scanzoni has removed one the size of a man's fist. Their growth is usually slow, but they may develop rapidly during pregnancy. Scanzoni states that they may spontaneously decrease in size, as do uterine fibromata at the end of the puerperium, and like uterine fibromata they may increase in size at the menstrual molimen.

[1] Winckel, p. 35. [2] *Cyclopædia of Obstetrics and Gynæcology*, vol. xii. p. 297.
[3] *Ibid.*, vol. xii. p. 298. [4] *Ibid.*, vol. xii. p. 301.

Little is known of the etiology of fibromata. Scanzoni[1] believes that they occasionally result from unabsorbed blood-clots in the labia. The symptoms are principally those which arise from the weight of the tumor and the inconvenience which it occasions as regards urination, walking, and coitus. It may also produce abrasions from the friction.

When the tumor is pedunculated the pedicle may be transfixed and the growth removed. If the tumor is sessile or the pedicle large, its capsule may be incised and the growth enucleated. The flaps of the resulting wound may be trimmed and united with sutures, or the cavity may be packed with antiseptic absorbent gauze.

Lipoma of the vulva may develop in the areolar tissue of the labium or mons veneris, and may attain a considerable size. Emmet[2] reports a case in which the tumor extended as far as the knees, and was suspended in a bag which hung from the patient's waist. Stegele[3] removed a lipoma of the vulva which weighed ten pounds. The tumors are soft to the touch and their shape is moulded by the pressure of the thighs. On section they are seen to be composed of subcutaneous cellular tissue lined with fat. The patient suffers only from the inconvenience of their size.

The treatment consists in the excision of the tumor. The wound may be partially or entirely closed according to the indications in the case.

Neuroma.—Only two cases of neuroma of the vulva are on record. Simpson[4] reports a case in which subcutaneous painful nodules existed near the meatus urinarius. Kennedy[5] describes small, sensitive nodules which were found on the nymphæ and vestibule, and which resulted from imperfectly healed ulcerations after delivery. He regards them as hypertrophied granulations not fully organized or covered by normal epithelium, and recommends their removal.

Pruritus of the Vulva.

Pruritus of the vulva is not a disease. It is a symptom of disease of the vulva, the vagina, the uterus, the uterine appendages, the bladder or the rectum, or of some systemic disease. It is so often impossible to isolate the cause of pruritus of the vulva that it has become customary for gynæcologists to treat of this condition as a disease rather than as a symptom.

Pruritus of the vulva may be caused by abnormal discharges or secretions from the vulva, vagina, uterus and its appendages, or bladder. It may be a symptom of vulvitis, of eruptive or parasitic

[1] *Op. cit.*, p. 302. [2] *American Journal of Obstetrics*, 1888, p. 601.
[3] *Zeitschrift für Chirurgie und Geburtshülfe*, Band ix. S. 243.
[4] Hart and Barbour, *Manual of Gynæcology*, p. 549. [5] Winckel, p. 48.

diseases, or of certain of the tumors. It may exist as a reflex symptom of rectal disease, as hæmorrhoids or fissure of the anus, or possibly of disease of other adjacent organs. The systemic diseases of which it may be a symptom are diabetes, lithæmia, and the various neuroses. Wilshire[1] and Friedreich[2] think it is produced by fungoid organisms, and support this assertion with the statement that parasiticides are the only curative remedies.

Pruritus occurs most frequently after the menopause, probably as a result of the atrophic changes in the vulva and the increased nervous irritability of the patient. The irritation is usually located at the junction of the labia majora and over the vestibule. It may extend, however, over the entire vulva, and frequently to and around the anus. The affected portion of the vulva ordinarily presents a whitish, mottled appearance, is dry, fissured, and partially covered by a cheesy substance, which under the microscope is seen to be composed chiefly of broken-down epithelial cells. It is not known whether these conditions are the result of disease or traumatism. The symptom is generally intermittent, but it may be remittent. It is more severe at night, when the patient is overheated or excited, and during the menstrual period. Masturbation may cause or may be an effect of pruritus.

The treatment consists, first, in the removal of the cause if possible; and, second, in the relief of the symptom. If disease of the vulva be present, it should be treated as previously described. If hæmorrhoids or anal fissures exist, their cure may result in relief of the symptom. The vulva should be kept free from all irritating discharges and secretions. The patient's general condition should always receive most careful attention. If the theory of Wilshire and Friedreich be true, parasiticides are indicated. When the vulva is dry, evaporating lotions and frequent bathing should be avoided, and it should be kept moist by the frequent application of oils or ointments. The multiplicity of remedies recommended would seem to indicate that none of them are certain to relieve the pruritus. Among these remedies may be mentioned the following:

Nitrate of silver may be used as described in the treatment of vulvitis. When the affected area is small, the solid stick may be employed.

Cocaine, 4 to 10 per cent. solution or ointment, for local use during the paroxysms.

Carbolic acid, 5 to 10 per cent. solution or ointment. Skene[3] recommends the use of carbolic acid and tincture of iodine, equal parts, by means of an atomizer with high pressure, so that the solution may be forced deeply into the tissues.

[1] *Virchow's Archiv*, Band xxx. S. 476. [2] *Brit. Med. Journ.*, Mar. 5, 1881.

[3] *Treatise on the Diseases of Women*, p. 96.

Salicylic acid, 2 to 5 per cent. ointment:

℞. Chloroformi purificati, fʒij;
Olei amygdalæ, fʒij.—M.
Sig. Apply when needed.

(*Scanzoni.*[1])

℞. Chloralis,
Camphoræ, āā. ʒss;
M. et adde—
Unguenti, ʒj;
Acidi borici, ʒss.—M.
Sig. Apply over affected area.

Subnitrate of bismuth.
Tincture of aconite.
Tincture of belladonna.
Tincture of lobelia.
Tincture of iodine.
Fluid extract of hamamelis.

℞. Ichthyol., gr. xx;
Vaselini (Chesebrough's), fʒj.—M.
Sig. Apply frequently.

Iodoform, saturated solution in ether. Apply with atomizer (Skene).[2]

Menthol. The solid stick or a 5 or 10 per cent. solution.

Electricity. Faradism is recommended by some, and galvanism by other authors.

When a sedative is required codeine should be employed, and preferably in the form of a suppository.

In obstinate cases Küstner[3] and Schroeder[4] advise excision of the affected area. The resultant wound should be treated in the usual manner by sutures, dressings, and the like.

DISEASES OF THE VAGINA.

Vaginitis.

Inflammation of the vagina may be simple, senile, or granular. Other forms of vaginitis are very rarely met with, such as emphysema-

[1] Hart and Barbour, p. 546.
[2] *Op. cit.*, p. 96.
[3] *Cent. für Gyn.*, No. 12, 1885.
[4] Pepper's *System of Medicine*, vol. iv. p. 394.

tous, exfoliative, diphtheritic, dysenteric, erysipelatous, and septic. These latter varieties will not be discussed here, because they seldom occur, and because their treatment is identical with that of the same inflammations in other parts of the body. The reader who desires more definite information regarding these rarer forms of vaginitis is referred to the exhaustive article by Breisky.[1]

Simple Vaginitis may result from irritating discharges or secretions from—

a, The vagina; that is, malignant disease.

b, The bladder, through a vesico-vaginal fistula.

c, The rectum, through a recto-vaginal fistula.

d, The cervix uteri; that is, malignant or glandular disease, ectropion.

e, The corpus uteri; malignant growths, endometritis.

f, Fallopian tubes; salpingitis.

g, Pelvic abscess discharging through the vagina.

Other prominent causes are the use of too hot, too cold, or irritating douches, the presence in the vagina of the sponges sometimes used during menstruation, badly-fitted pessaries, excessive or violent coitus, onanism, exanthematous eruptions, ascarides, and the retention of menstrual blood in the vagina.

The vaginal mucous membrane is reddened, sore, at first dry, and later on bathed with a profuse muco-purulent discharge. The friction, discharge, and inflammation often cause a loss of epithelium in patches. The rugæ are less marked on account of the swelling. The mucous membrane is infiltrated. Many bacteria are present in the discharge. The inflammation seldom extends into the uterus or urethra, but usually spreads over the vulva.

The patient has a burning sensation or may even suffer from severe pain in the vagina, from pruritus, and from a feeling of weight or tenesmus in the pelvis, with frequent desire to urinate. She may, however, avoid urinating on account of the smarting which it produces, and so retention from over-distension of the bladder may result. Irritation and tenesmus of the rectum are somewhat common symptoms.

The treatment should consist of the employment of measures to relieve the cause. In severe cases rest in the recumbent posture should be maintained. Excessive pain should be controlled by opiates, preferably in the form of rectal suppositories. In the dry stage, injections of oil, diluted glycerin, or flaxseed tea, as hot as can be well borne, will be very grateful to the patient. These injections may be rendered antiseptic by the addition of carbolic acid, boric acid, or creolin. When the pain is severe cocaine may be added, but care should be taken that

[1] *Cyclopædia of Obstetrics and Gynæcology*, vol. x. p. 305.

the solution contains not more than 2 per cent. of cocaine, and that only a small quantity be used at each injection.

Emmet[1] recommends the use of hot douches at a temperature of about 110° F., to be continued for twenty or thirty minutes, and to be frequently repeated. Hot sitz-baths will also give relief. The same effect may be produced, without so much disturbance of the patient, by means of the hot hip-pack, which should be applied as follows: A sheet, preferably a flannel sheet, is folded lengthwise so as to form a bandage about eighteen inches wide. This is rolled, immersed in boiling water, and wrung out or preferably passed rapidly through a clothes-wringer. The hot sheet should now be wrapped around the pelvis and covered with a dry flannel blanket. The pack should be allowed to remain as long as it feels warm to the patient; that is, as a rule, from thirty to sixty minutes.

When there are discharges from the uterus, Fallopian tubes, or from an abscess, frequent cleansing douches are indispensable. In cases of vesico-vaginal fistulæ the vagina should be protected by frequent douches and by the free use of ointment. A favorite remedy of Emmet's is prepared by heating together beeswax and zinc-oxide ointment in the proportion of 1 to 2 drachms to the ounce.

The urine should be kept acid by the removal of all phosphatic deposits from the vagina or bladder, and by the administration of the following preparation, which has been used for several years in the New York State Woman's Hospital:

℞. Acidi benzoici, ʒj;
Sodii boratis, ʒij;
Glycerini, fʒss;
M. and triturate thoroughly, and add
Aquæ, q. s. ad fʒvj.
Sig. Two to four tea-spoonfuls four to six times daily as required.

When benzoic acid nauseates the patient, sweet apple cider may be substituted.

When recto-vaginal fistula exists, the vagina should be kept free from fæcal matter by douches, and should be protected by the free use of the zinc-oxide-and-beeswax ointment.

Ascarides, if present, should be removed by rectal injections of infusion of quassia, an ounce to the pint, or of carbolic-acid solution, ½ of 1 per cent.

Nitrate of silver is probably the most useful local remedy in the treatment of vaginitis. Its action is so nearly specific that its use may be recommended in all stages of the disease. In the acute stage it

[1] P. 631.

diminishes the pain and soreness, and seems to have a specific effect upon the inflammation. In the stage of discharge it diminishes the secretion, makes it thin, whitish, and watery, and forms a thin eschar over the eroded surfaces. It has also an antiseptic action. The nitrate of silver should be applied as follows: Place the patient in the left lateral position and expose the vagina by means of Sims's speculum. A solution of nitrate of silver, from 20 to 60 grains to the ounce, is now applied to the vagina by means of an atomizer or a swab. By gradually withdrawing the speculum the posterior vaginal wall may also be thoroughly medicated. A 4 per cent. solution of cocaine may be first applied as a local anæsthetic. If the burning sensation due to the nitrate of silver be prolonged, a douche of a weak solution of common salt will give relief, or the vaginal walls may be thoroughly smeared with vaseline. Applications of the nitrate-of-silver solution may be repeated every second day for two or three times. The bowels should be kept free and coitus should be prohibited.

When the discharges are muco-purulent, the astringent antiseptic douches mentioned in the treatment of vulvitis are indicated. At this stage of the disease powders may be employed to diminish secretion, to take up the discharge, and to prevent decomposition. They also prevent friction by causing mechanical separation of the vaginal walls, and stimulate repair of the eroded surfaces. A most useful preparation for this purpose is a mixture of iodoform and powdered starch in the proportion of 1 : 4. One to two drachms of this powder may be applied once or twice a day according to the necessities of the individual case. If the odor of iodoform is objectionable, aristol may be substituted. Subnitrate of bismuth, oxide of zinc, or boric acid may also be employed. Engelmann[1] recommends the free use of these powders on tampons. The dressing should be renewed when it becomes soiled.

Senile Vaginitis is probably the result of atrophic changes, particularly in the vaginal glands and follicles. This variety of vaginitis is characterized by a reddish, mottled appearance of the mucous membrane, which becomes eroded. The inflammation frequently produces extensive and firm plastic adhesions. The discharge is whitish and thinner than that of simple vaginitis.

The treatment consists in the breaking up of adhesions, in keeping the vaginal walls well lubricated with oils and ointments, and in the avoidance, as far as is consistent with cleanliness, of all douches, either plain or astringent. The patient should rest quietly to avoid friction, and strict cleanliness should be observed.

Granular Vaginitis seldom occurs. It is most frequently observed during gravidity. The granular appearance is produced by swelling of the papillæ. The epithelium over the papillæ is wanting, but be-

[1] *American Journal of Obstetrics*, June and July, 1887.

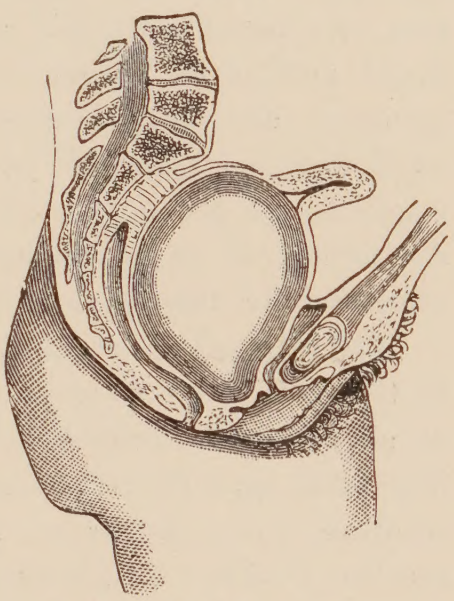
tween the papillæ the epithelium is thickened and infiltrated with small cells.

The treatment consists in keeping the affected surfaces clean and free from irritating discharges, and in the destruction of the granules by the application of a strong solution of nitrate of silver or by the curette. The vagina should then be treated according to the indications already given in the consideration of simple vaginitis. In the cases in which pregnancy coexists palliative measures alone should be employed.

Atresia of the Hymen.

Imperforate and firm hymen is often due to an adhesive inflammation of the folds of the hymen which may possibly have occurred during fœtal life (Hart and Barbour).[1] As a rule, no subjective symptoms are observed until puberty, but the accumulation of mucus has caused distress at an earlier period in a few cases. The patient may suffer intensely from menstrual disturbances, with retention of the menstrual secretion. These disturbances are usually increased with each successive menstrual period. The retention of the menstrual secretion causes first dilatation of the vagina, the hymen bulges out between the labia, and the vaginal walls become thickened. The resultant tumor may entirely fill the pelvic cavity, and may extend even into the abdominal cavity. The bladder and rectum may become irritable on account of the pressure. The uterus may remain unchanged above and in front of the tumor, or it may be dilated or become a part of the tumor. The Fallopian tubes may also be dilated, but Schroeder[2] states that this is not due to regurgitation, but rather to hæmorrhage from the lining membrane of the tube itself. Cases have been reported in which the tube was dilated and its uterine end occluded. The dilated tube may rupture and produce an hæmatocele, or the retained secretion may escape through the fimbriated extremity into the peritoneal cavity and become encysted, or may remain free in the peritoneal cavity, and peritonitis or death result.

Fig. 7.



Atresia of the Hymen (after Schroeder).

The patient may not only suffer severely at the menstrual molimen, but the pain due to the dilatation and pressure may become continuous, and insomnia, impoverished nutrition and marked anæmia result. The retained menstrual secretion is of a chocolate-brown color, thick, viscid,

[1] P. 512.

[2] Hart and Barbour, p. 513.

odorless, and not clotted. Chemical examination of the secretion has demonstrated that its viscidity is due to reabsorption. Under the microscope broken-down blood-corpuscles and epithelial cells, together with granular débris, may be observed.

The treatment of atresia of the hymen with extensive accumulation of menstrual secretion is not devoid of danger. Fatal results have followed both the slow and the rapid methods of evacuation. The danger consists in the rupture of the dilated Fallopian tube and the breaking up of adhesions and the consequent septicæmia. In order to guard against the two first-named dangers care should be taken never to exert pressure over the tumor, and that the primary incision be small. The incision may be enlarged if no unfavorable symptoms result from the escape of the fluid. Septicæmia should be guarded against by scrupulous surgical cleanliness as regards the field of operation, the instruments, the assistants, and the operator. The relatively rapid method of evacuation, which has just been described, is conservative, and will, I believe, give the best results. The only possible advantage in the method of evacuation by the aspirator or small trocar might be the prevention of rupture of the dilated Fallopian tube and the avoidance of adhesions. The danger of septicæmia, however, is increased by this method.

The retained secretion, which easily undergoes decomposition, should be thoroughly removed by free irrigation. Care should be taken that no air enter the cavity either through the incision or the irrigating tube. The fluid used for irrigation should be sterilized water; carbolic-acid solution, $\frac{1}{2}$ of 1 per cent.; bichloride of mercury, 1 : 3000; boric acid; creolin, 1 : 500; or Thiersch's solution. The solutions should be carefully prepared with sterilized water. The cavity should then be tightly packed with iodoform gauze. The dressing should be changed after twenty-four or forty-eight hours. After moderate contraction of the cavity has taken place it may be necessary to insert Sims's glass vaginal dilator to keep the vaginal opening patent.

If after the evacuation a tumor of the Fallopian tube should still remain, it must be removed by abdominal section.

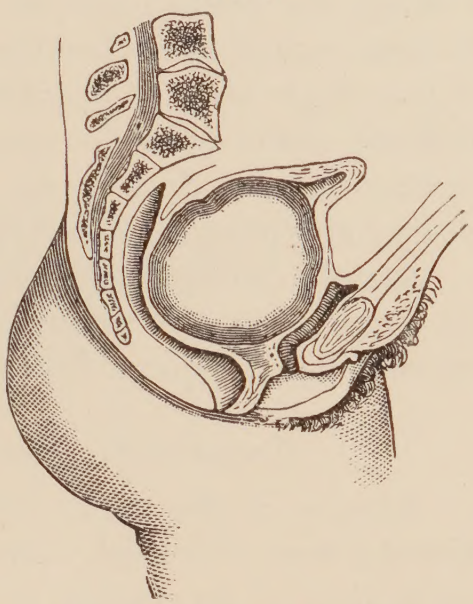
Atresia of the Vagina

may involve a portion or the whole of the vagina, but it most frequently occurs in the lower third. It may occur at several points in the vagina. When there is atresia of the entire vagina, the uterus and its appendages are apt to be imperfectly developed.

Acquired atresia of the vagina may result from cicatricial contraction following sloughing after labor, operations, or injuries, or from fevers which may produce an inflammation or lowered nutrition of the vagina. It may also result from adhesive inflammation.

In atresia of the vagina there may be retention of the menstrual secretion, as in atresia of the hymen, or the uterus and uterine appendages may be so imperfectly developed that menstruation can never take place.

FIG. 8.



Atresia of Vagina, lower third (after Schroeder).

Atresia with Menstruation.—If the obstruction is near the vaginal outlet, the symptoms and treatment will be the same as in atresia of the hymen. The tumor caused by the retained menstrual secretion, however, may include only a portion or none of the vagina. Under these circumstances the vagina should be opened in the following way:

With the forefinger of the left hand in the rectum as a guide, and with a sound in the bladder so as to determine the thickness of the septum, a transverse incision is made through the skin of the perineum. This opening is extended to the uterus by tearing through the tissues by means of the finger or other blunt instrument. The uterus is now punctured and the retained secretion evacuated, as described in the consideration of Atresia of the Hymen.

FIG. 9.

Atresia of the Vagina (after Breisky).

Great care will be necessary to prevent the vagina from closing

again. Crédé[1] recommends that a flap be made in the labium and stitched to the uterus. Emmet[2] keeps the vagina open until the surface heals, by means of Sims's glass vaginal dilator. Tait[3] states: "When the atresia amounts practically to an absence of the vagina, so that a sound in the urethra can be felt in the rectum as if there was only a single layer of membrane between them, operative measures are difficult, risky, and by no means certain to give permanent relief." He further states: "Such a case now I should treat by the removal of the uterine appendages; I should not open the hæmatokolpos at all."

Atresia without Menstruation.—So little can be accomplished by operation in this variety of atresia that, as a rule, it is best not to attempt any measures for the relief of the condition.

Cicatricial Contraction of the Vagina.

Atresia of the vagina resulting from cicatricial contraction has already been discussed, hence only those contractions which produce narrowing of the vagina or changes in the relative position of the pelvic organs will be considered here.

Cicatrices may result from sloughing, from cauterization, or from operation. The most common cause of sloughing is protracted labor. Sloughing may follow as a result of lowered vitality after fevers or diphtheritic or erysipelatous inflammation. Narrowing of the vagina may interfere with coitus, may obstruct labor, may produce malpositions of the uterus and irritability of the bladder or rectum, and may interfere with the function of the ureters. It may occasion vaginismus and dyspareunia. There may also be continuous pain localized in the cicatrix. Leucorrhœa is frequently present. The amount of cicatricial tissue depends directly upon the amount of sloughing that has taken place. The symptoms may be direct—that is, referable to the cicatrix; or indirect—that is, referable to the displaced organs.

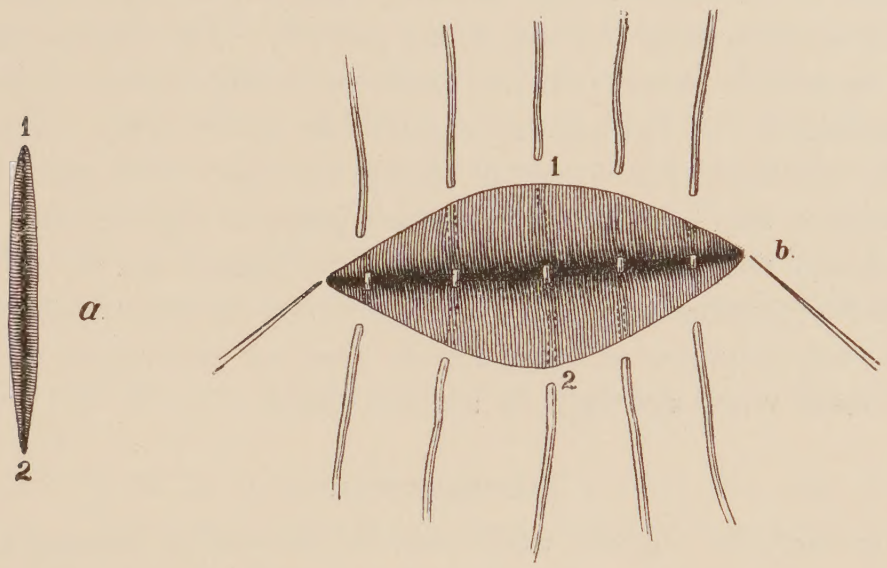
Before the cicatrization has become firm, much benefit may result from stretching or dilatation with the finger, followed by the use of an elastic tampon or Sims's glass vaginal dilator. For the tampon antiseptic lamb's wool should be used. If the wool produces irritation, the tampons may be covered with antiseptic gauze or a film of absorbent cotton.

The operative treatment consists in thorough division of the cicatricial bands. Emmet's method is probably the only one which gives permanent relief. He incises the cicatricial band until all resistance to the touch ceases. A tenaculum is then inserted into each lip of the wound at its mid-point. Traction is now made so that the long axis of the wound is at right angles to its original direction. The next step in the operation is the insertion and tying of deep sutures in a direction

[1] *Archiv für Gynäkologie*, Band 22, S. 229. [2] P. 188. [3] P. 94.

parallel to the line of incision. The tenacula separate the ends of the cicatricial band and the sutures maintain this separation.

FIG. 10.



The after-treatment consists in keeping the patient quiet until the wound is healed, and in the use of mild antiseptic douches. The sutures should be removed after two to four weeks. If the cicatricial contraction be extensive, it may not be advisable to complete the operation at one sitting.

RELAXATION OF THE VAGINAL WALLS.

Relaxation may affect the anterior, the posterior, or both vaginal walls. It results from subinvolution following pregnancy or from continued tension upon the connective tissue of the vaginal walls. This tension may be due to pelvic tumors, enlargement of the uterus, pressure from above upon the pelvic organs, as from ascites, abdominal growths, tight lacing, etc., or to want of support to the pelvic organs from below, as in lacerations. Subinvolution following pregnancy is always the result of increased pressure from above or of diminished support from below. In both subinvolution and constant tension the vaginal walls contain an excess of plastic exudation, and as a result the connective tissue becomes softened and the circulation increased. The patient suffers not only from the relaxation, but from disease of other organs, of which the relaxation is a symptom.

The treatment consists in the removal of the cause, in keeping the patient off her feet as much as possible, and in the use of hot plain or astringent vaginal douches. Glycerin may also be applied to the vagina upon wool or cotton tampons for the purpose of depleting the thickened vaginal walls. The douche should be given as follows:

The patient should lie on the back, the hips elevated, the legs flexed. A douche-pan should be placed under the hips or the rubber sheet may

be used. When the rubber sheet is used the patient should lie across the bed with her hips elevated near the edge, her feet placed on two chairs, between which should be placed a pail to receive the water. A douche-pail or fountain syringe holding from two to eight quarts should be placed at least three feet above the patient. The vaginal tip of the syringe should be passed into the posterior fornix of the vagina. The water should be as hot as the patient can easily bear. The douche should be continued for twenty or thirty minutes. The position of the patient makes the introitus the highest point of the vagina; thus the douche keeps the vagina distended, and a small stream of water is sufficient to maintain the distension and keep up the desired temperature. Alum, sulphate of zinc, tannic acid, or bichloride of mercury may be used when astringents are indicated.

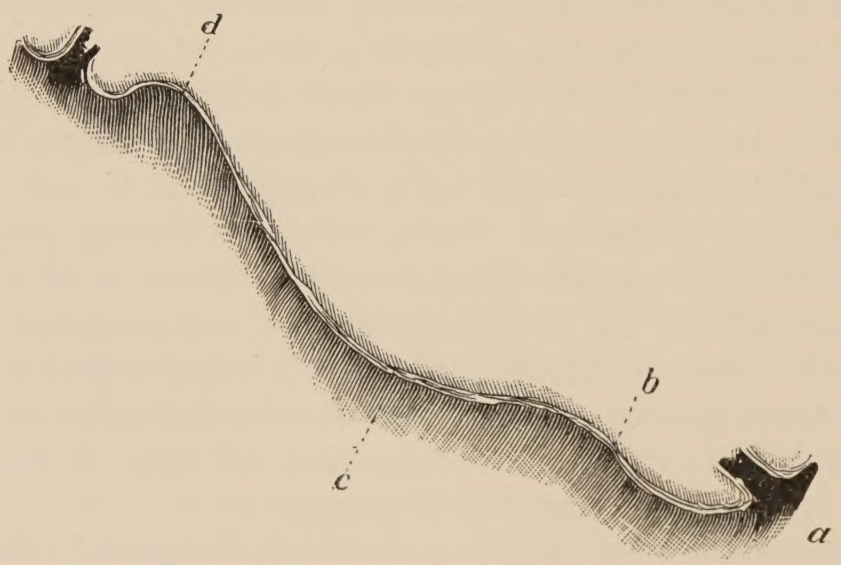
Lacerations.

One or both the vaginal walls may be the seat of laceration.

Laceration of the Anterior Vaginal Wall.—As the anatomy, physiology, nature, and description of this lesion have not been thoroughly discussed heretofore, I will quote freely from a paper on this subject which I presented before the Chicago Gynæcological Society, April 17, 1891, and which was published in the *American Journal of Obstetrics*, August, 1891:

In the consideration of lacerations of the pelvic floor all the authorities, so far as I have been able to determine, have considered only the

Fig. 11.



rupture of its muscles. It is unphysiological to attribute continuous support to muscles, therefore the connective tissue alone remains to be considered. The connective tissue of the anterior vaginal wall forms a tense, firm band across the vagina opposite the neck of the bladder, which becomes gradually thinner as it approaches the uterus and as it

extends along the urethra. It is attached to the bony pelvis on either side, and its reticular arrangement is such that it permits much more longitudinal than transverse freedom of motion; that is, it is so arranged as to give elastic support to the uterus and to prevent prolapse of the urethra and bladder. The tension which this band gives to the vagina is apparent to the touch; and on introducing a Sims's speculum, with the patient in the left lateral position, the effect upon the anterior vaginal wall can be easily seen (see Fig. 11); that is, from the introitus vaginæ to the uterus the anterior vaginal wall presents—

1. A convexity corresponding to the urethral curve (Fig. 11, *a–b*).

2. A marked concavity opposite the trigone of the bladder (Fig. 11, *b–c*).

3. A straight line or a slight convexity from this point to the uterus (Fig. 11, *c–d*).

When this fascia is intact and involuted urethrocele and cystocele cannot occur. The prevailing theory that urethrocele and cystocele are dependent upon and cannot occur without laceration of the posterior vaginal wall is erroneous, because—

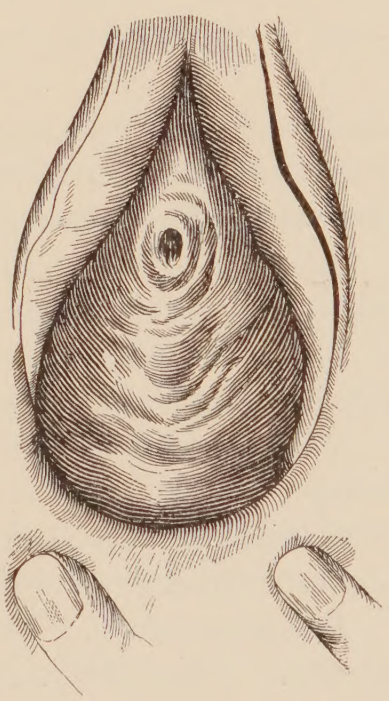
1. Extensive laceration of the posterior vaginal wall, even through the sphincter ani, frequently occurs without urethrocele or cystocele.

2. Urethrocele and cystocele occur without laceration of the posterior vaginal wall.

3. Incision of the posterior vaginal wall —that is, artificial laceration—never produces urethrocele or cystocele.

This time-honored fallacy may be explained by the fact that both walls of the vagina are often simultaneously ruptured, and that the posterior rupture is much more apparent than the anterior.

FIG. 12.



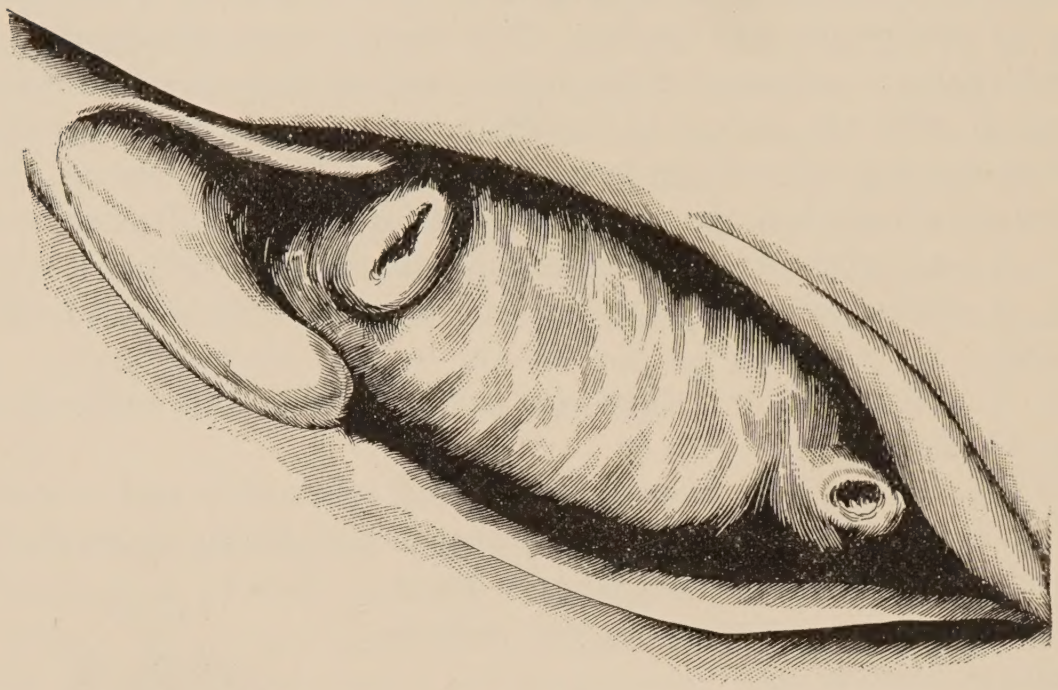
Laceration of the anterior vaginal wall may be either unilateral or bilateral. I have never met with a case of median laceration, and have been able to find only one case on record (Mundé).[1] The lesion is usually submucous, and occurs at or near the insertion of the fascia into the bony pelvis. It often deprives the horizontal rami of the pubes of their fascial covering for a variable distance from the urethra, and may involve the levator ani muscle, as mentioned by Emmet[2] and Schatz.[3] The location and extent of the laceration are easily detected

[1] *American Journal of Obstetrics*, June, 1890. [2] P. 370.

[3] *Centralblatt für Gynäkologie*, No. 40, 1883.

by touch, and verified by inspection of the abnormal curvature of the anterior vaginal wall. (See Figs. 12 and 13.) The amount of the

FIG. 13.



urethrocele and cystocele which results is entirely dependent upon the extent and location of the laceration and upon the amount of involution which has taken place.

Etiology.—The child's head, in its passage through the parturient canal, may produce laceration of the anterior vaginal wall—

1. By the tension and pressure incident to the engagement of the vesico-vaginal septum between it and the pubes.

2. By tearing and grinding of the connective tissue from its attachment.

Schatz[1] mentions anterior laceration of the levator ani muscle by instruments, and advises against oblique application of forceps.

Symptomatology.—The objective symptoms have already been considered. The subjective symptoms, which are dependent upon the amount of urethrocele and cystocele, are—

1. Partial incontinence of urine. The urine escapes upon exertion, such as coughing, sneezing, laughing, walking, lifting, or as soon as the desire to urinate is experienced.

2. Total incontinence of urine.

The other subjective symptoms are those which are described in the textbooks in the consideration of cystocele and prolapse of the uterus.

Diagnosis.—The diagnosis depends upon the recognition of the local lesion and of the resultant symptoms.

[1] *Op. cit.*

Treatment.—I. Prophylaxis. The prophylactic treatment consists—

1. In the support of the vesico-vaginal septum while the fœtal head is entering the true pelvis—that is, the prevention of the engagement of the vesico-vaginal septum between the head and the pubes.

2. In the prevention of excessive pressure of the head upon the pubic arch (Schatz).[1]

3. In the employment of the usual measures for hastening involution.

II. Operation. The rational operative treatment is to restore, as far as possible, the lacerated fascia to its normal condition. The usual operations on the anterior vaginal wall have failed to accomplish this result, because—

1. They roll together tissues not involved in the laceration.

2. They include so little connective tissue that, as a rule, no permanent support is obtained.

3. Retroposition of the uterus frequently follows.

4. They produce little or no effect upon the urethrocele.

The multiplicity of median operations on the anterior vaginal wall would seem to indicate that the results of these operations have been more or less unsatisfactory.

An operation to be rational—

1. Must be upon the portion of the anterior vaginal wall which has been torn; that is, it must bring together, as far as possible, the lacerated tissues.

2. Must include much of the pelvic fascia of the anterior vaginal wall.

3. Must neither shorten the anterior vaginal wall nor bring the lateral walls of the vagina together in front of the uterus.

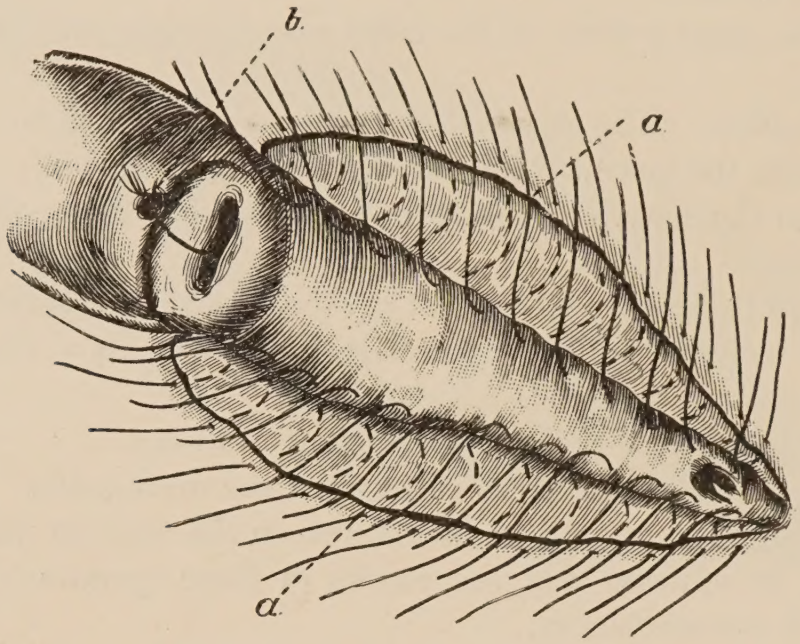
The unsatisfactory results of the median operations induced me to attempt a lateral operation which I have performed twenty times, and which has in every case practically fulfilled the indications. The technique is as follows:

The patient being placed in the left lateral position, the anterior vaginal wall is exposed by Sims's speculum, and a point to the side of the urethra, near its meatus, caught by a tenaculum. The denudation is commenced at this point, and extends along the antero-lateral walls of the vagina to a point beyond the prolapse. This point may be opposite the neck of the bladder, or the denudation may extend even as far as the lateral aspect of the cervix uteri. The breadth of the denuded surface is dependent upon the extent of the urethrocele and cystocele; that is, it should be sufficiently wide to take in all the redundant tissue of the urethrocele and cystocele. (See Fig. 14, *a*.) The denudation may be upon one or both sides, according as the lace-

[1] *Op. cit.*

ration is unilateral or bilateral. Should the denuded surface extend beyond the neck of the bladder, the cervix uteri should be drawn firmly upward and backward while the sutures are being inserted and tied. For this purpose I have adopted the method recommended by

FIG. 14.



Dr. E. C. Dudley[1] in the technique of Emmet's operation for procidentia, of fastening the cervix uteri to the end of the speculum by means of a suture. (See Fig. 14, *b*.)

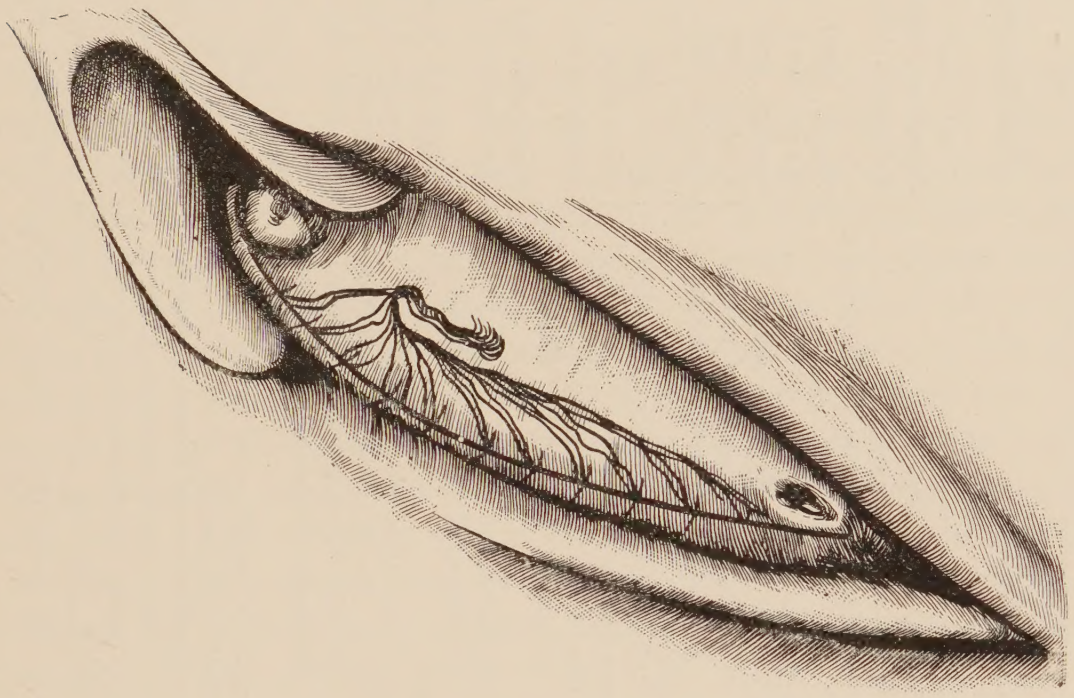
Beginning at the uterine end of the denudation, buried silkworm-gut sutures are now passed from side to side in a curved line which has its convexity directed outward and forward. Each suture as inserted is tied, and traction is exerted toward the cervix while the next suture is being introduced and tied. The sutures should include as much connective tissue as possible, care being taken not to injure the bladder, ureters, or urethra. After passing the base of the trigone of the bladder the sutures should be passed deeply into the lateral wall, so as to include the fascia of the posterior vaginal wall near its insertion into the pubes, and as deeply into the anterior vaginal wall as the increased thickness of the vesico-vaginal septum from this point outward will permit. The fixation suture should now be removed without making traction on the cervix. The ends of the sutures should be left long and should be turned into the vagina. (See Figs. 15 and 16.)

The after-treatment consists in the measures usually employed in plastic operations upon the vagina. The use of the catheter should, if possible, be avoided. The stitches may be removed after a week, or may be allowed to remain for two or three weeks, according to the requirements of the individual case.

[1] Pepper's *System of Medicine*, vol. ii. p. 162.

The operation has entirely fulfilled both the mechanical and symptomatic indications, except in one case, in which, on account of suppuration around some of the sutures, only partial relief was obtained. Up to this time, so far as I have been able to ascertain, the results of operation have been permanent.

FIG. 15.



On the next page is a tabular statement of the 20 cases in which I have performed this operation, and of 3 cases operated upon by Dr. Lyons, my assistant at the Post-Graduate Medical School.

In a recent conversation with Professor Skene he made the suggestion that, instead of denuding in this operation, a small opening be

FIG. 16.

made at the side of the urethra, into which a probe should be inserted and forced up underneath the vaginal mucous membrane to a point just beyond the urethrocele or cystocele—that the mucous membrane be divided upon the probe as a director, the flaps dissected up, and the fascia brought together with sutures.

In case of median laceration the fascia should be exposed by a median denudation or flap-splitting, and united by means of sutures.

TABULAR STATEMENT.[1]

No.	Name.	Date of Injury.	Lesion.	Indications.	Date of Operation.	Result.
1	Mrs. H. . .	1885	Bilateral laceration .	Urethrocele. Total incontinence of urine	February, 1890 . .	Cure.
2	Mrs. C. . .	1880	Unilateral laceration .	Urethrocele. Total incontinence of urine	February, 1890 . .	"
3	Mrs. C. . .	1887	Bilateral laceration .	Urethrocele. Cystocele. Prolapse of uterus. Partial incontinence of urine	March, 1890 . . .	"
4	Mrs. T. . .	1888	"	Urethrocele. Partial incontinence of urine	March, 1890 . .	"
5	Mrs. F.[2] . .	1882	"	Urethrocele. Cystocele. Total incontinence of urine . . .	April 3, 1890 . . .	"
6	Mrs. K. . .	1887	"	Urethrocele. Cystocele. Partial incontinence of urine . .	June 6, 1890 . . .	"
7	Mrs. T. . .	1888	"	Urethrocele. Cystocele. Partial incontinence of urine . .	June 9, 1890 . . .	"
8	Mrs. N. . .	1885	"	Cystocele. Prolapse of uterus	June 15, 1890 . .	"
9	Mrs. W. . .	1886	"	Urethrocele. Cystocele. Partial incontinence of urine . .	July, 1890	"
10	Mrs. D. . .	1886	"	Urethrocele. Partial incontinence of urine	July, 1890	"
11	Mrs. Y. . .	1889	"	Cystocele. Prolapse of uterus	August, 1890 . . .	Partial relief.
12	Mrs. C. . .	1882	"	Urethrocele. Cystocele. Prolapse of uterus. Partial incontinence of urine	September 22, 1890	Cure.
13	Mrs. H. . .	1884	"	Urethrocele. Partial incontinence of urine	September 27, 1890	"
14	Mrs. E. . .	1888	"	Urethrocele. Cystocele. Prolapse of uterus. Almost total incontinence of urine	October 6, 1890 . .	"
15	Mrs. S. . .	1887	Unilateral laceration .	Slight urethrocele. Partial incontinence of urine	November 8, 1890 .	"
16	Mrs. H. . .	1887	Bilateral laceration .	Urethrocele. Slight cystocele. Partial incontinence of urine	December, 1890 . .	"
17	Mrs. McG. .	1885	"	Urethrocele. Cystocele. Partial incontinence of urine . .	December 10, 1890	"
18	Mrs. M. . .	1884	"	Urethrocele. Cystocele. Prolapse of uterus. Partial incontinence of urine	March 4, 1891 . .	"
19	Mrs. C. . .	1886	"	Slight urethrocele. Partial incontinence of urine	March, 1891 . . .	"
20	Mrs. A. B. .	1888	Unilateral laceration .	Slight urethrocele. Partial incontinence of urine	March, 1891 . . .	"
21	Mrs. F.[3] . .	1888	Bilateral laceration .	Urethrocele. Cystocele. Partial incontinence of urine . .	September 3, 1890 .	"
22	Mrs. H.[3] . .	. .	"	Urethrocele. Cystocele. Partial incontinence of urine . .	September 25, 1890	"
23	Mrs. G.[3] . .	1890	"	Urethrocele. Cystocele. Partial incontinence of urine . .	March 15, 1891 . .	"

[1] In the 6 cases in which prolapse of the uterus was one of the indications for the operation the result, so far as this condition is concerned, must be understood to refer only to the effect produced upon the uterus by the restoration of that portion of its elastic support furnished by the anterior vaginal wall.

[2] This patient had already undergone two median operations without any relief.

[3] Cases operated upon by Dr. Lyons.

Laceration of the Posterior Vaginal Wall.—Under this heading will be discussed all lacerations of the posterior vaginal wall, "submucous tears which produce prolapse," "so-called laceration of the perineum," "laceration of the perineum through the sphincter ani," etc. The laceration may be median, bilateral, unilateral, or mixed.

Median laceration may be slight, may extend to, or may even involve, the rectum. It usually results from rapid or instrumental labor.

Bilateral laceration is usually submucous, and involves, as a rule, only the connective tissue at or near its insertion into the bony pelvis. It may, however, involve the levator ani muscle at or near its insertion. The perineal body retains nearly or entirely its normal size, but is dislocated backward; nevertheless, this form of laceration causes more suffering to the patient, on account of lack of support, than does any of the other varieties. The descending ramus of the pubes and the portion of the ischium about and including the spine apparently remain covered by periosteum and the vaginal mucous membrane only.

Rectocele exists as a result of the detachment of the band-like connective tissue which stretches across the pelvis in front of and around the rectum. The rectocele may be obscured from view by the perineal body when the patient is recumbent, but want of support to the rectum is felt by the patient while at stool or while standing, and is recognized by digital examination when the abdominal muscles are contracted.

The transversus perinei and levator ani muscles may be injured by the laceration, and, by failing to overcome the increased pressure of lifting, straining, jumping, etc. on the anterior rectal wall, may allow this connective-tissue band to relax and double upon itself as the rectocele forms. The ends of the separated fibres, however, do not remain free, for an adhesive inflammation takes place soon after labor, forming a weak attachment to the bony wall at a variable distance from their original location.

Unilateral Laceration.—Cases are occasionally seen in which the tear is nearly, if not entirely, limited to one side. The tear may be mucous or submucous, and involves the same structures as the bilateral laceration, but only on one side of the vagina. When the tear is submucous it is probably always caused by the engagement of the connective tissue between the fœtal head and the bony canal. When the mucous membrane is injured, however, the laceration may be caused by the forceps.

Mixed Laceration may be a combination of the unilateral and median or of the bilateral and median varieties.

The only important muscles involved in laceration of the posterior vaginal wall are—the sphincter ani, because it is the voluntary muscle

of the bowel; the levator ani, because its action is to overcome the increased pressure upon the pelvic floor from lifting, jumping, straining at stool, etc.; and the transversus perinei, because its action is to prevent bulging of the rectal wall into the vagina during defecation.

Attention will here be paid chiefly to the connective tissue, for upon this the posterior vaginal wall depends entirely for its continuous support. The connective tissue is liberally attached to the bony portion of the true pelvis, and is abundantly distributed throughout the posterior vaginal wall. This tissue becomes soft and yielding at parturition, and at this time normally stretches without separation, so as to permit the passage of the fœtal head. The head is moulded to the bony canal in its passage, which demonstrates that the connective tissue during labor is normally capable of stretching to the dimensions of the canal. Therefore when the posterior vaginal wall is lacerated during labor the lesion must be due to one or more of the following causes:

a. Diseased Connective Tissue.—Cicatricial contraction is the disease most apt to affect the connective tissue. This is a rare complication and can seldom obtain in primipara.

b. Too great force brought to bear upon the posterior vaginal wall before its connective tissue is sufficiently softened; that is, rapid labor. This almost invariably results in median laceration.

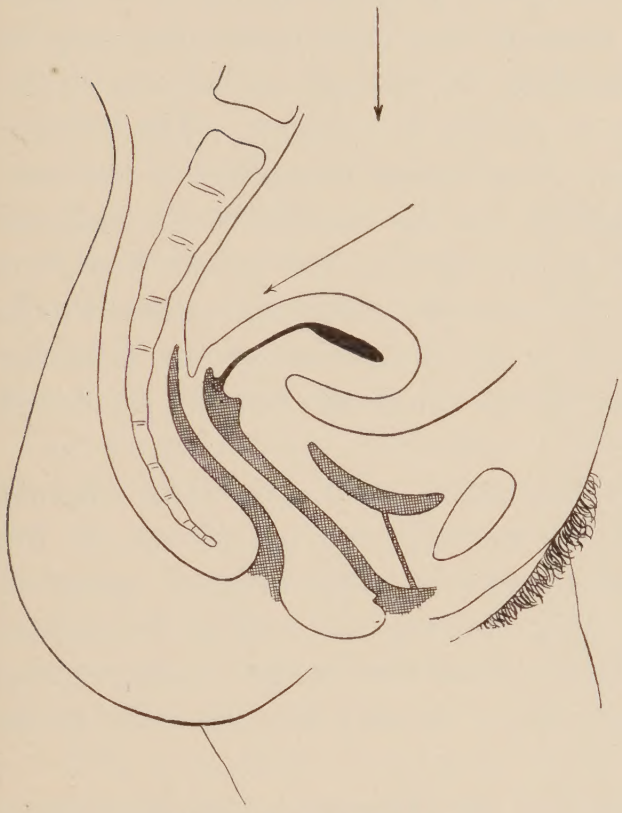
c. Scraping, tearing, or grinding of the connective tissue from its bony attachment during the passage of the fœtal head. This always occurs in difficult and protracted labors, and produces lateral laceration as a result of the abnormal relation between the diameters of the fœtal head and the pelvis. It had not been recognized heretofore as a cause of the "so-called laceration of the perineum," excepting in a communication which I made to the *Medical Record*, July 27, 1889.

The patient may suffer from lack of support to the pelvic organs and from partial or entire incontinence of fæces and intestinal gases. This condition may obtain even when the visible tear does not extend to the sphincter ani. On careful observation, however, the continuity of the muscle will be seen to be incomplete.

Rectocele may result from laceration, as was stated in the consideration of the bilateral variety. Prolapse of the uterus may follow laceration—first, by the change in the direction of the vaginal canal whereby the intra-abdominal pressure, instead of being exerted approximately at right angles to the normal axis of the vagina, is exerted in the direction of the abnormal axis of the vagina which results from the lesion; that is, the axis of the vagina, instead of being nearly parallel with the plane of the pelvic inlet, forms an acute angle of perhaps thirty degrees with it. Prolapse of the uterus may also be a direct result of the impairment of the support which the posterior vaginal wall gives to this organ.

The subjective symptoms—namely, backache, "bearing-down" sensations, and dragging pain in the inguinal regions—all result from the loss of support consequent upon the lesion. From the prolapse may result retroposition, subinvolution, congestion, œdema, and hyperplasia of the uterus.

Fig. 17.



Normal Axis of Vagina.

Laceration of the posterior vaginal wall is recognized by inspection and palpation. Inspection reveals the amount of the mucous membrane involved in the laceration, by the loss of continuity in the remains of the hymen, and by the resultant cicatrix. The amount of the tear may be estimated by approximating the separated carunculæ myrtiformes. Inspection also reveals the backward dislocation of the perineal body which results from lateral lacerations.

Palpation is employed to detect submucous tears, which are nearly if not always lateral. The finger is passed into the vagina and pressed down on either side along the descending ramus of the pubes and the ramus of the ischium, and the amount of resistance noted. The amount of laceration is indicated by the diminution of the normal elastic resistance. In extensive lacerations the finger may be passed back even as far as the spine of the ischium without encountering great resistance.

Fig. 18.

Axis of Vagina as changed by laceration of posterior vaginal wall.

Lacerations of the posterior vaginal wall may often be pre-

vented by proper care. Extensive cicatricial bands should be treated as described under that head. Rapid labor may be avoided by the use of anæsthetics and anodynes and by direct pressure against the down-coming head. When laceration becomes imminent episiotomy may be performed. This is best accomplished by making an incision in the postero-lateral wall of the vagina to relieve the tension. The incision may be unilateral or bilateral according to the necessities of the case. Tears resulting from the use of forceps may be avoided by the removal of the instrument after the head is brought to the pelvic floor, but before it is delivered, and also, in cases in which this procedure is not practicable, by using great care to avoid incision of the posterior vaginal wall by the blades of the forceps when the handles are flexed over the pubes.

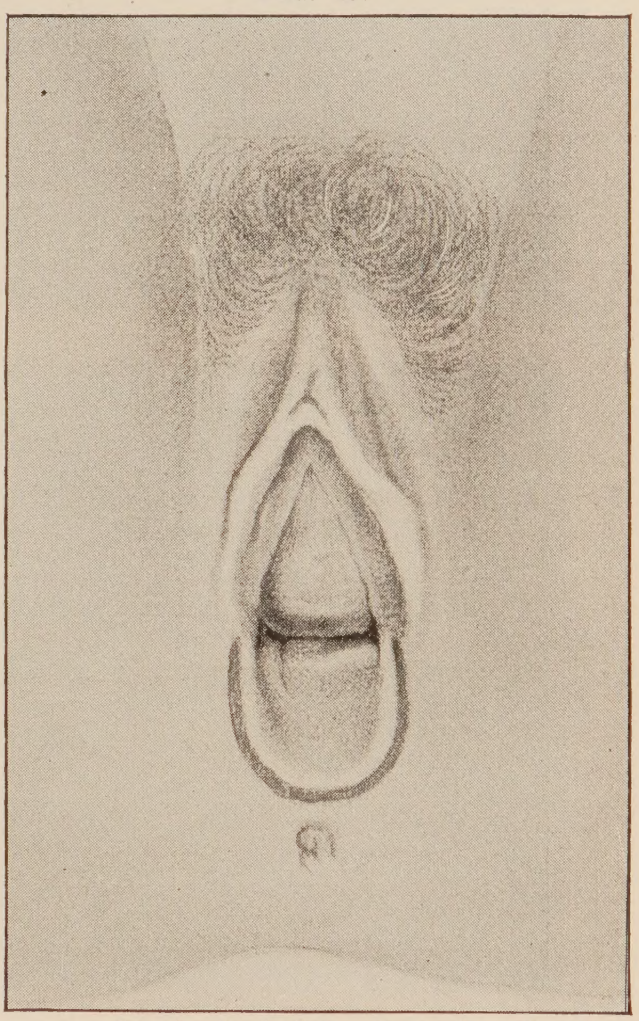
Under operative treatment of lacerations of the posterior vaginal wall the deferred operation will be the only one considered, as the immediate operation is described elsewhere. The rational operation consists in the restoration of the posterior vaginal wall, as far as possible, to its normal condition. It is essential to recognize the variety and extent of the tear, upon which must depend the operation to be made.

Median Laceration not including the Sphincter Ani Muscle.—Unless the laceration is so extensive as materially to change the direction of the vaginal canal, and consequently to diminish the indirect support of the pelvic viscera, repair of the lesion is not indicated. When operative treatment is indicated the rational method of operation is to expose the separated connective tissue by denudation or flap-splitting, and to bring it together by means of sutures. I consider Tait's method of flap-splitting the best operation for this variety of laceration. The patient having been prepared in the usual manner, the technique of the operation is as follows: The patient being anæsthetized and placed in the lithotomy position, the tissues at the vaginal outlet are put upon the stretch laterally. The sharp point of a scissors is now introduced into the lowest caruncle on one side, and an incision is made along the muco-cutaneous line to the lowest caruncle on the opposite side, the depth of the incision being dependent upon the extent of the lesion and the size of the perineal body (Fig. 19).

The vaginal flap is now elevated by means of two or three forceps, and the incision deepened if necessary, and the lateral walls of the wound are approximated by sutures, which are introduced as follows: A needle armed with silkworm gut is passed immediately beneath, but not so as to include the skin, on the left side of the wound near its lower angle for a distance of half an inch to an inch, and is then carried deeply through the connective tissue on that side

up to the median line. It is then passed down so as to include like structures on the opposite side, and is brought out at the corresponding spot on the right side, and tied. Other sutures are now introduced in like manner from below upward until the wound is completely closed. It is immaterial whether the suture is entirely buried or is brought out at the upper angle of the wound and then reinserted. Either a straight or curved needle may be used. I prefer Emmet's straight trocar-pointed needle, an inch or an inch and a half long. The supplementary incisions as described by Tait seem to me to be useless. Continuous irrigation should be employed while the sutures are being introduced and tied (Figs. 20 and 21).

Fig. 19.



The separated connective tissue may be exposed by making a triangular denudation as follows: A tenaculum is inserted into the lowest caruncula myrtiformis on each side, and a third tenaculum inserted in the posterior vaginal wall, in the median line, at a point sufficiently high that all the redundant tissue may be included in the triangle thus formed. The surface included within these three points is now denuded. A tenaculum is then inserted into the apex of the denuded surface and traction made toward the cervix. Commencing at the apex, sutures of silkworm gut are introduced in a curved line which has its convexity directed downward and backward. Each suture is introduced and tied, and traction is exerted in the direction of the urethra while the next suture is being inserted and tied. Each succeeding suture is treated in like manner. The surface should be cleansed by continuous irrigation while the sutures are being introduced and tied. In cases where the denudation is very broad the tissues can be better coaptated by the use of a figure-of-eight suture. (See Fig. 23.)

Median Laceration through the Sphincter Ani Muscle.—The flap-splitting operation is the best for the relief of this lesion. The technique is easy and the result more certain than from any other

Fig. 20.

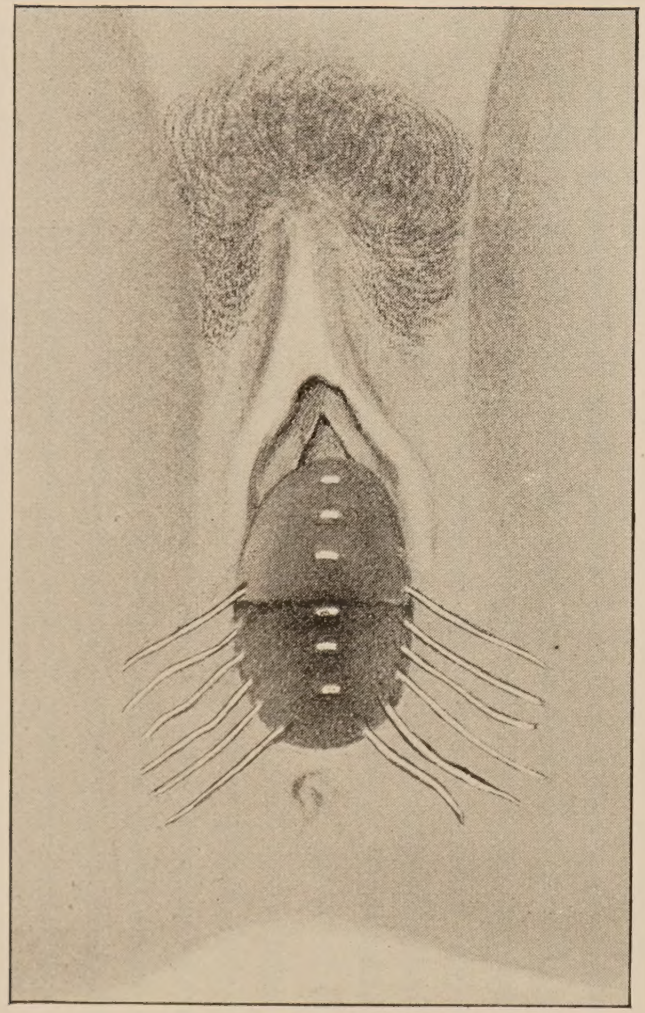


Fig. 21.

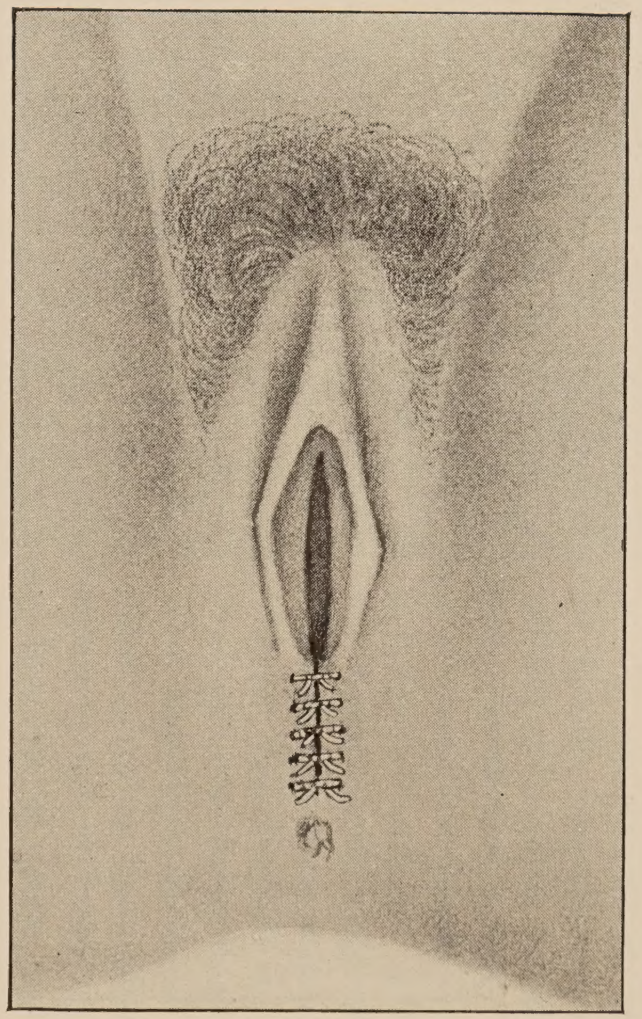


Fig. 22.

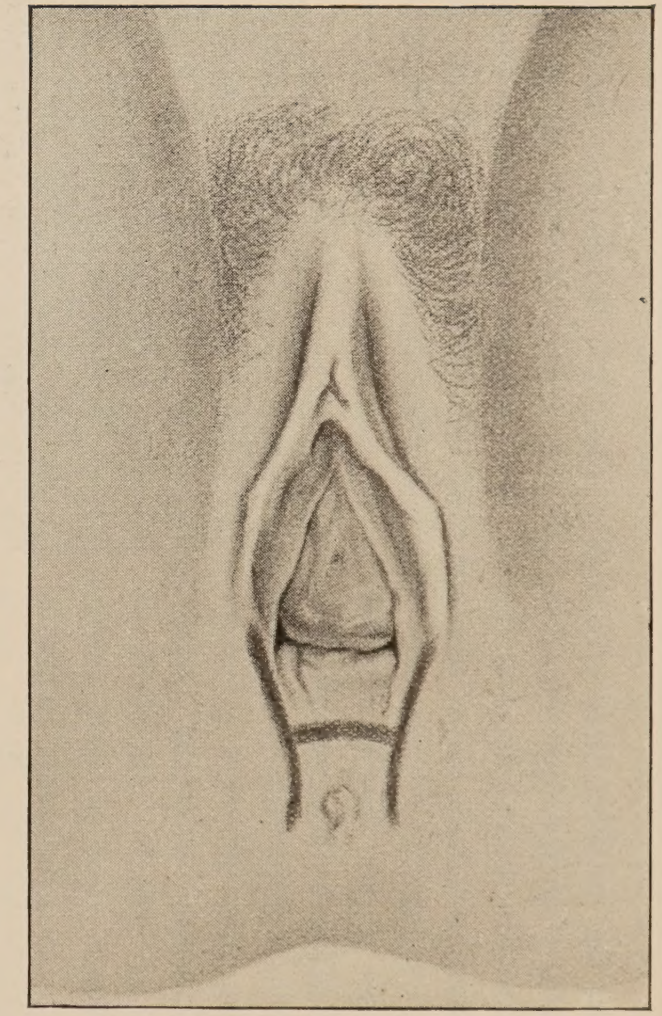


FIG. 23.

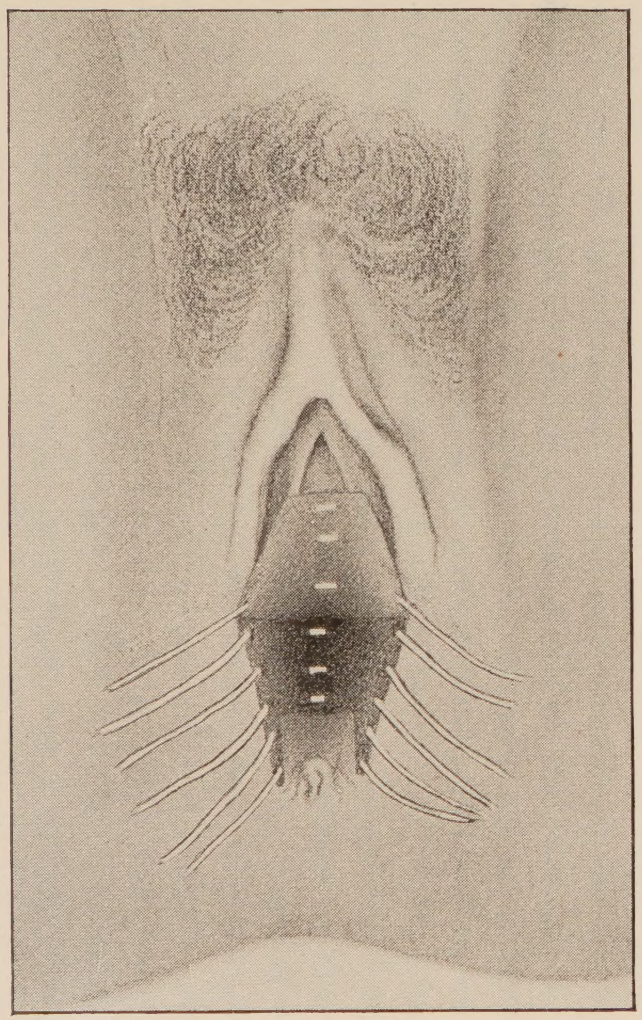


FIG. 24.

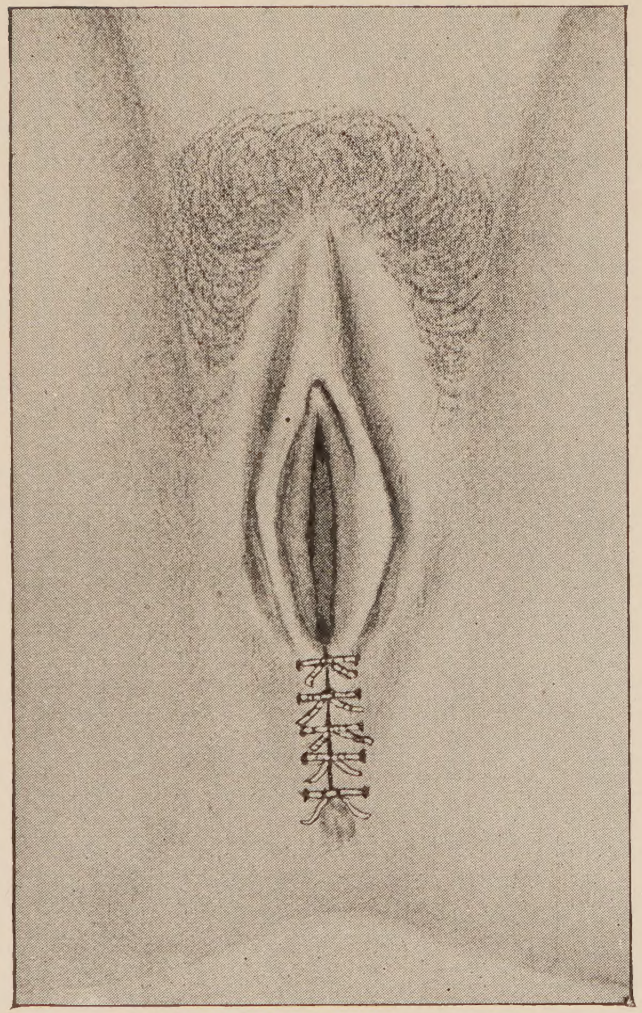
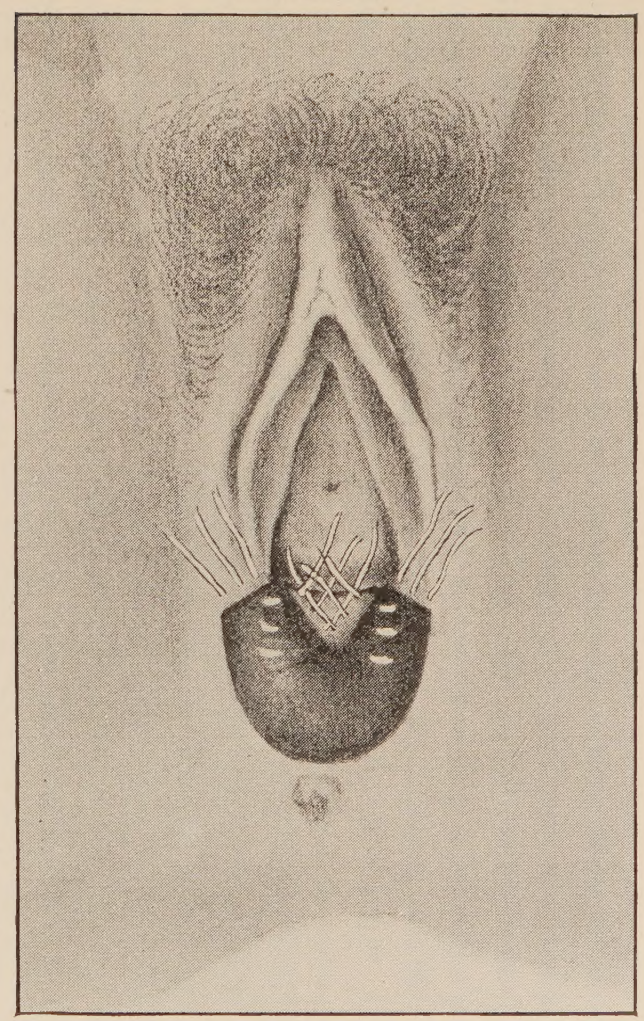


FIG. 25.



method of operation. The patient being anæsthetized and placed in the lithotomy position, the point of the scissors is inserted deeply into the lowest caruncle on the left side, and an incision carried directly downward to a point about a quarter of an inch beyond and to the side of the bowel. A similar incision is made on the opposite side, and a third incision connecting these two is made, so as to split the recto-vaginal septum (Fig. 22).

The vaginal flap is now dissected upward, and a small triangular flap at each side, posterior to the rectum, is dissected downward so as to expose the sphincter ani muscle.

A suture is now introduced under the skin on the left side so as to include the torn end of the sphincter ani muscle. It is then passed up through the connective tissue across the rectal flap of the recto-vaginal septum, then down so as to include similar structures on the opposite side, and finally brought out at the corresponding point on the right side and tied. The tissues included in this suture should form a complete septum between the vagina and rectum. The remaining sutures should be treated as described above in the flap-splitting operation for incomplete laceration. When the laceration involves an inch or more of the rectal wall it may be advisable to build up a recto-vaginal septum before fully restoring the tear (Figs. 23 and 24).

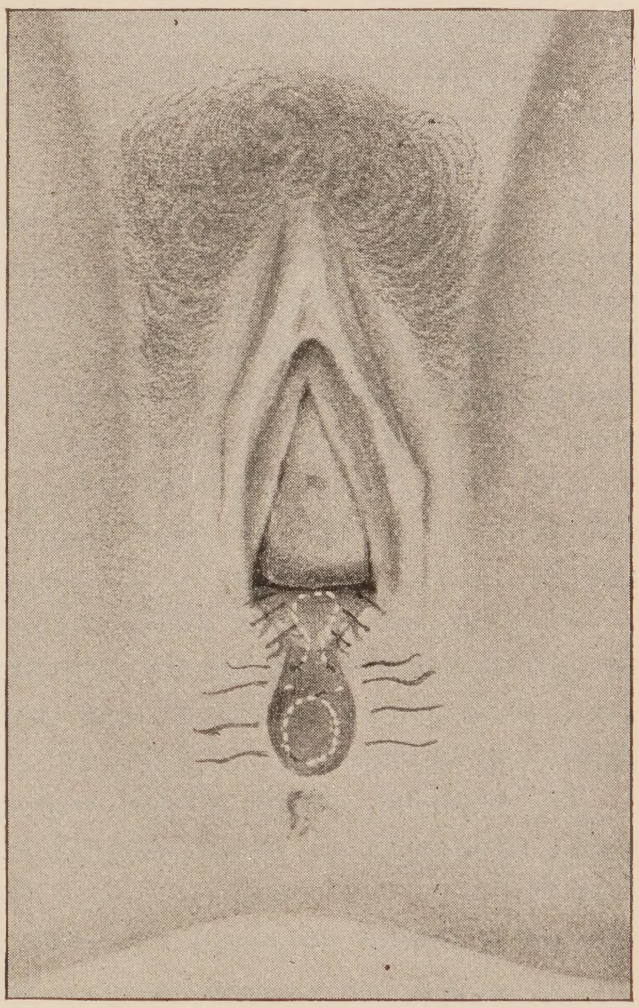
Bilateral Laceration.—Emmet's operation in the only rational one for the repair of this lesion of the posterior vaginal wall. The technique of the operation is as follows: The patient being anæsthetized and in the lithotomy position, and the nates being separated by assistants, the lowest caruncula myrtiformis on the left side is caught up by a tenaculum. Tenacula are also inserted in the crest of the rectocele in the median line and in the centre of the posterior vaginal wall at the muco-cutaneous junction. The triangular surface thus formed is denuded; the denudation also extends upward and forward from the line of the rami of the ischium and pubes. The length of this line of denudation should depend upon the extent of the laceration and the amount of redundant tissue. A similar denudation is made on the opposite side. The object of the denudation along the line of the rami of the ischium and pubes is to expose the connective tissue and thereby ensure firm support.

A tenaculum is now inserted in the upper angle of the denudation on the left side, and held firmly up toward the urethra while a trocar-pointed straight needle armed with silkworm gut is passed through the angle and tied. This suture is held firmly up toward the urethra while the succeeding suture is being introduced and tied. Each succeeding suture is treated in the same way. The denudation on the opposite side is treated in like manner. The crown stitch is now introduced.

It should pass deeply under the lowest left caruncle, through the crest of the rectocele under the mucous membrane, and should be brought out beneath the lowest right caruncle and tied. This suture when tied restores the annular hymen, unless the remains of that organ have been obliterated. The median sutures are next introduced deeply from side to side and tied.

All the sutures should be passed in a curved line whose convexity is directed downward and backward, so as to include as much connective tissue as possible and yet not injure the rectum. Continuous irrigation should be used while the sutures are being introduced and tied. The ends of the sutures should be left long, and may either be turned into the vagina or allowed to remain outside (Figs. 25 and 26).[1]

FIG. 26.



Unilateral Laceration.—The amount and extent of the tear should be recognized, and then the injured connective tissue should be exposed by denudation or flap-splitting, and brought together by means of sutures. This can, as a rule, be best accomplished by the Emmet operation, just described, upon the affected side.

Mixed Laceration.—In this class of lacerations it is necessary to expose the injured connective tissue either by denudation or flap-splitting, and to bring it together by means of sutures. These lacerations are so variable in location and extent that the nature of the operation must be varied according to the needs of each individual case.

An antiseptic pad should be placed over the perineum and retained firmly in place by a T-bandage until the patient has recovered from the effects of the anæsthetic. The pad should be changed when it becomes soiled.

[1] In Figs. 25 and 26 the operation is more intravaginal than it is possible to illustrate by drawings.

In Fig. 26 the dotted lines represent the direction of the crown suture and of the figure-of-eight suture.

The after-treatment of all lacerations of the posterior vaginal wall, excepting those including the sphincter ani, is the same. In the latter the bowels should be made to move freely every day until the wound is healed. The patient should remain in the recumbent posture for one or two weeks, and should not be allowed to do much standing or walking for a month or more. Tying the knees of the patient, as generally advised, is uncomfortable to the patient and does not in any way relieve the tension on the perineum.

Anodynes are seldom required, but should be given when much pain exists. Sedatives and soporifics should be administered if necessary to produce quiet and sleep. Hot and prolonged vaginal douches will generally be sufficient to allay soreness and pain. The use of the catheter should be avoided if possible. The patient may be held in the sitting posture to urinate if necessary. Hot douches and hot applications over the bladder will occasionally enable the patient to urinate. The urine should be kept from contact with the perineum by the use of the perineal shield, which has been already described, or a small douche may be used after each urination. The bowels should be moved on the second or third day, and after this time their action should be kept regular.

The diet should be liquid for the first two or three days, after which the patient may be allowed the ordinary diet. On and after the second day antiseptic douches of carbolic-acid solution, $\frac{1}{2}$ of 1 per cent., or bichloride of mercury, 1 : 4000, should be given twice daily.

The external sutures should remain in place for ten days or two weeks; the internal sutures should be allowed to remain for two to four weeks. Care should be taken that the union is not impaired by the manipulation necessary to the removal of the sutures.

Vaginismus.

It is unfortunate that vaginismus has been treated as a disease, for in reality it is only a symptom. This so-called disease has been very generally described as a contraction of the sphincter vaginæ muscle. Tait[1] is probably correct when he states that such a muscle does not exist, and his opinion is shared by many eminent anatomists. Physical examination demonstrates that vaginismus is not a contraction of the sphincter vaginæ muscle, but is chiefly, if not entirely, due to contraction of the levator ani, transversus perinei, and bulbo-cavernosus muscles. In vaginismus these muscles are abnormally irritable, and a reflex, painful, spasmodic contraction occurs as a result of disease of the vulva, as fissures, erosions, or irritable growths; of diseases of the urethra, as fissures or caruncles; of diseases of the vagina, as erosions, irritable growths, and caruncles; of diseases of the uterus, as retro-

[1] *Op. cit.*, p. 78.

position, tumors, and laceration of the cervix; of prolapsed or painful ovaries and tubes; or of pelvic inflammations. The reflex contraction results from irritation of the diseased area, but may occur from dread of touch or pressure over the parts affected. I have observed these muscles in the condition which Sayre describes as contracture. This condition of the affected muscle or muscles may be detected by pressure upon the posterior vaginal wall with the finger in the vagina.

The patient is usually nervous and irritable; she suffers from dyspareunia or sexual intercourse is absolutely impossible. Injuries to the vulva and vagina may be present as the result of attempts at sexual intercourse.

The treatment consists in the removal of the cause if possible. Hypersensitiveness of the caruncles alone will be considered here, as the other diseases which may produce vaginismus have been discussed elsewhere. The remains of the hymen should be entirely excised by denudation, which should commence on one side of the urethra and extend around the vagina to the opposite side. The denudation will be from a quarter to half an inch wide, and the resultant wound should be closed with sutures, preferably of catgut, as they produce less irritation. It should be remembered that in the use of catgut sutures the wound should be kept as dry as possible, in order to prevent early softening, stretching, and absorption of the sutures. Douches should therefore be avoided, and in their stead antiseptic powders, such as iodoform, boric acid, oxide of zinc, or aristol, should be applied. The patient should remain quiet until the wound is well healed, and sexual intercourse should be absolutely interdicted until the tenderness at the seat of operation has disappeared.

If the vaginismus refuse to yield to this treatment, or if it is impossible to determine the cause, relief may be obtained by division of the tendons of the contractured muscles. This method of treatment seems to me far more rational than the old method of median perineal section. The operation must necessarily be done under local or incomplete anæsthesia. After the division of the tendons the wound in the mucous membrane should be closed by sutures.

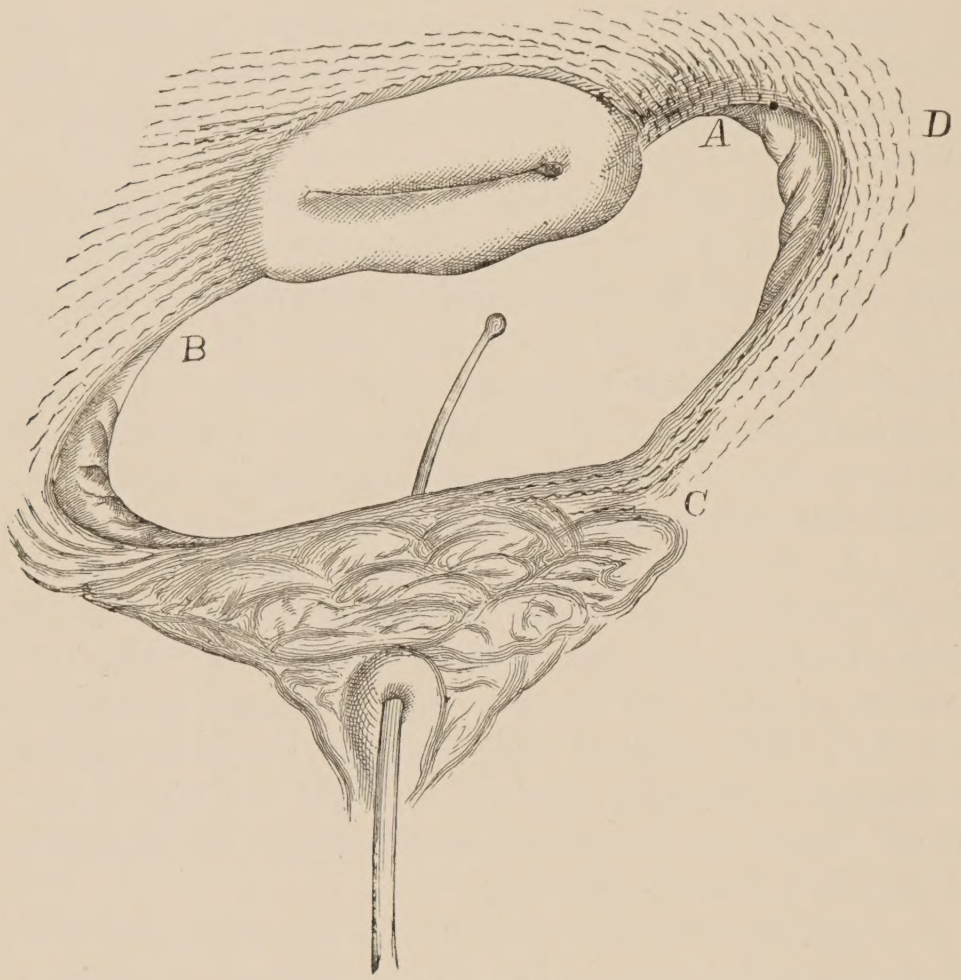
Fistulæ.

The varieties of fistulæ of the vagina are—vesico-vaginal, recto-vaginal, urethro-vaginal, utero-vesico-vaginal, and uretero-vesico-vaginal. Owing to the better care of obstetric cases which now obtains, fistulæ are of much less frequent occurrence than formerly.

Vesico-vaginal Fistula may vary in extent from a pinhole opening to a lesion involving the entire anterior vaginal wall from the urethra to the cervix uteri. The direction of the long axis of the fistula is most commonly at right angles to the axis of the vagina.

The opening may, however, be circular, or its long axis may be parallel with or oblique to that of the vagina. The edges of the wound are thickened and inflamed, and are frequently covered with phosphatic deposits. Hernia of the bladder through a large fistula is not uncommon, and it may even protrude through the vulvar orifice. This variety

FIG. 27.



(After Emmet.)

of fistula almost always results from sloughing due to prolonged engagement of the vesico-vaginal septum between the fœtal head and the bony pelvis. It may result, however, from trauma, malignant ulceration, vesical calculi, or ill-fitting pessaries.

The patient suffers from partial or complete incontinence of urine. If the opening is very minute, urine may escape only when the bladder becomes distended or when the patient is standing, coughing, etc. When the fistula results from sloughing, incontinence of urine will not occur until the necrosis has extended through the septum ; that is, until three or more days after labor. Cystitis may and usually does occur as a result of the continuous contact of the vesical mucous membrane with decomposed urine and phosphatic deposits. Hernia of the bladder will also produce inflammation of its mucous membrane. The irritating urine produces inflammation of the vagina and vulva, and may even

cause extensive erosions of these organs. The irritation may be greatly intensified by phosphatic deposits.

The history of the case will usually indicate the character of the lesion. If the patient be placed in the left lateral position and the perineum retracted by a Sims speculum, the location and extent of the fistula may usually be seen. If the fistulous openings are very minute, they may be detected by injecting milk or a dilute solution of permanganate of potassium into the bladder.

The diminution in the number of cases of vesico-vaginal fistula demonstrates that it can, as a rule, be prevented by the preservation of the anterior vaginal wall, which is usually injured by engagement of the vesico-vaginal septum between the fœtal head and the bony pelvis or by impaction of the fœtal head in the pelvis. The former is accomplished by supporting the septum with the finger as the head becomes engaged, and the latter by the early and judicious use of the forceps.

The preparatory treatment consists in the correction of the quantity and quality of the urine, if necessary; in the removal of phosphatic deposits; in the cure of erosions; in the protection of the vagina and vulva from urine; in the division and stretching of cicatricial bands in the vagina; and in the general care of the patient. The urine should be kept acid by the administration of the benzoic-acid mixture:

℞. Acidi benzoici, ʒij;
Sodii boratis, ʒiv;
Glycerini, fʒss.—M.
Triturate thoroughly and add—
Aquæ, q. s. ad fʒvj.
Sig. A tea-spoonful to a table-spoonful every three to six hours, as indicated.

The quantity of urine may be increased by increasing the amount of liquids taken. Phosphatic deposits may be removed mechanically or by douching with a weak solution of acetic acid. The strength of the solution must depend upon the tolerance of the patient. Erosions should be touched with a solution of nitrate of silver 20 grains to the ounce, and the surface protected by the use of the zinc-oxide-and-bees-wax ointment described in the consideration of Vulvitis. Frequent applications of the same ointment should be made to protect the vagina and vulva thoroughly from contact with the urine.

Cicatricial bands should be treated as described under that head. Stretching may be produced by the use of hard-rubber or glass vaginal dilators or by sponges or tampons. The sponges should be covered with a non-irritating substance, such as oiled silk or rubber tissue,

which should be perforated to admit moisture. The cicatricial bands should, if possible, be so divided and stretched as to permit easy coaptation of the edges of the fistula.

Tonics, forced nutrition, diuretics, etc. should be given when indicated in order to improve the general condition of the patient.

The essential features in the operative treatment of vesico-vaginal fistulæ are—

(*a*) To bring the edges of the wound together in the direction of least tension. The nearer the line of union is parallel with the long axis of the vagina the less will be the interference with the position of the uterus. The line of union may be straight, curved, or angular.

(*b*) The edges of the fistula should be freshened, and the denudation on the vaginal side should give a broad surface for coaptation, and should extend a sufficient distance in the direction of the line of approximation to prevent the occurrence of folds.

(*c*) The sutures should be of silkworm gut or silver wire, and should include not less than one-eighth of an inch of tissue on each side of the fistula. They should also extend down to, but not through, the mucous membrane of the bladder. They should be placed regularly at intervals of about one-eighth of an inch.

Great care should be taken to wash out all the blood-clots from the bladder before tying or twisting the sutures, and to see that no hæmorrhagic points remain in the vesical surface of the wound. If silkworm-gut sutures are used, the ends should be left long and turned into the vagina. If silver sutures are used, the ends should be treated according to the method of Emmet. Skene uses waxed-silk sutures for closing vesico-vaginal fistulæ, and with good results. When the wound is closed the coaptation should be so perfect that when milk or a dilute solution of permanganate of potassium is injected into the bladder, none will escape into the vagina.

In cases of large or very irregular fistulæ it may be impracticable to attempt the entire closure at one sitting. In case the fistula is too large to be closed as described, the cervix uteri may be fastened into the lower end of the fistula. This may cause the uterine discharges to escape into the bladder. In such cases the patient suffers no especial discomfort after the operation. Another method is to fasten the lower edge of the fistula to the posterior vaginal wall. The flaps from the labia may be utilized in the closure of the fistula. The vulva may be nearly closed by means of a pad held firmly against the vulva, so as to give the patient control over the urine.

The patient should remain in bed for two or three weeks after the operation, and the urine should be kept acid by the use of the benzoic-acid mixture. A self-retaining catheter may be continuously worn : for this purpose Sims's sigmoid block-tin catheter is probably the best. The

catheter should be flexible, and should be so bent as to fit perfectly in each individual case. It should be changed and thoroughly cleansed every twelve hours. Skene advises frequent catheterization, but some operators allow their patients to void urine voluntarily. The bladder may be washed out with a 2 per cent. solution of boric acid if indicated. The vaginal surface of the wound should be kept clean by frequent douching. The sutures may be removed after ten days or may be allowed to remain for two or three weeks. The after-treatment is in other respects similar to that of all plastic operations upon the vagina.

Recto-vaginal Fistula is of infrequent occurrence. The fistulæ are usually small, and are most frequently located immediately above the perineal body, but they may occur anywhere in the recto-vaginal septum. The most common cause is in all probability syphilitic ulceration, but they may result from abscesses, trauma, including injuries due to labor, badly-fitted pessaries, or malignant ulceration. Sloughing around the sutures used in perineorraphy may produce a recto-vaginal fistula. Flatus or flatus and fæcal matter may escape through the fistula into the vagina. When the opening is minute, however, only flatus will escape. When fæcal matter escapes into the vagina it will produce vaginitis and vulvitis. The fistula may be detected by vision, by touch, by passage of a probe, by the presence of a purulent discharge, or by the injection of milk or permanganate-of-potassium solution into the rectum.

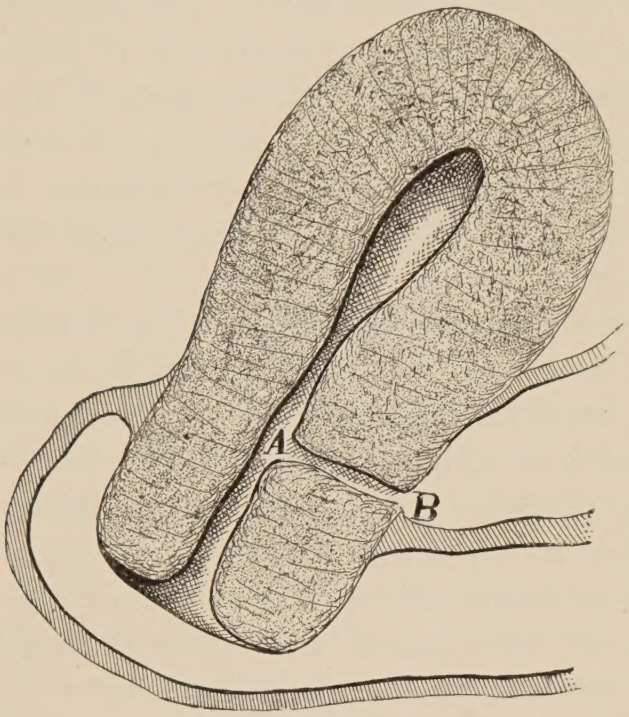
Small fistulæ may be cured by keeping the sphincter of the bowel paralyzed by means of dilatation and by cauterizing the track of the fistula. For thorough dilatation of the sphincter ani anæsthesia is necessary. The operative treatment of recto-vaginal fistula is along the same lines as that of vesico-vaginal fistula, with this exception: that when the fistula is nearer the sphincter of the bowel it may be advisable to cut through all the tissue of the posterior vaginal wall external to the fistula; that is, to change the lesion into a laceration of the posterior vaginal wall through the sphincter ani. When this has been done the track of the fistula should be thoroughly excised before the wound is closed.

Urethro-vaginal Fistula.—When the opening of the fistula is so located that it produces partial or total incontinence of urine, it should be closed according to the rules already laid down in the treatment of Vesico-vaginal Fistula. The urine may be passed voluntarily or a self-retaining catheter may be worn.

Utero-vesico-vaginal Fistula.—The fistula may open from the bladder into the uterus or it may be continuous with a vesico-vaginal fistula. The etiology, symptomatology, and diagnosis are practically the same as in vesico-vaginal fistula. When the fistula opens directly

from the bladder into the uterus, it can be closed only by incising the cervix up to the fistula. The fistulous tract into the uterus should then be thoroughly excised. The wound should be treated as a laceration of the cervix, care being taken to place deep sutures in the angle of the wound. When the fistula is continuous with one in the vesico-vaginal septum, the edges of the uterine portion may be vivified and closed in the manner above described, leaving only a simple vesico-vaginal fistula for further treatment.

Fig. 28.



Fistulous Tract after Healing of a Laceration of the Cervix Uteri (after Emmet).

Uretero - vesico - vaginal Fistula.—In this variety of fistula the ureter is involved in the lesion, and may open into the vagina or may discharge through the edge of the fistula. In such cases the ureter should first be turned into the bladder by partial closure of the fistula, and the remainder of the fistula should be left to be closed at a subsequent operation. To guard against injury of the ureter, a flexible sound or catheter should be passed through the urethra and into the ureter. This catheter should remain *in situ* while the portion of the fistula around the ureter is being closed.

Tumors of the Vagina.

Cystoma.—Cysts are the most common tumors of the vagina. They may be divided, according to their contents, into liquid and gaseous cysts.

Liquid Cysts.—These tumors may be classified as mucous, interstitial, and paravaginal. They vary in size from a minute collection of fluid to a cyst as large as an orange. A case has been reported of a vaginal cyst of the size of a fœtal head. They are most commonly located upon the anterior vaginal wall, but may occur on the posterior or lateral wall. They are more frequently observed in the lower third of the vagina, but may occur in the middle or upper third. The mucous membrane covering vaginal cysts is usually so stretched as to obliterate the rugæ, and is lighter in color than the surrounding mucous membrane. The cyst-wall consists of connective tissue, but when the cyst occurs in Gärtner's canal or in the remains of Müller's ducts its

wall contains muscular tissue. The cyst is lined with epithelium or endothelium. Its contents may resemble the fluid of hydrocele, but may be reddish, brownish, or even chocolate-colored. The fluid may be thin or viscid. Upon microscopical examination it may be seen to contain broken-down epithelial cells, granular matter, cholesterin crystals, and blood-corpuscles. Cysts may develop in the vaginal glands or crypts, in Gärtner's canals, in the remains of Müller's ducts, in the lacunæ, or in the lymphatic vessels. They may result from vaginitis, which closes the ducts, forming retention cysts; from trauma, which includes the injuries of labor; from the hyperæmia of gestation and the resultant increased secretion.

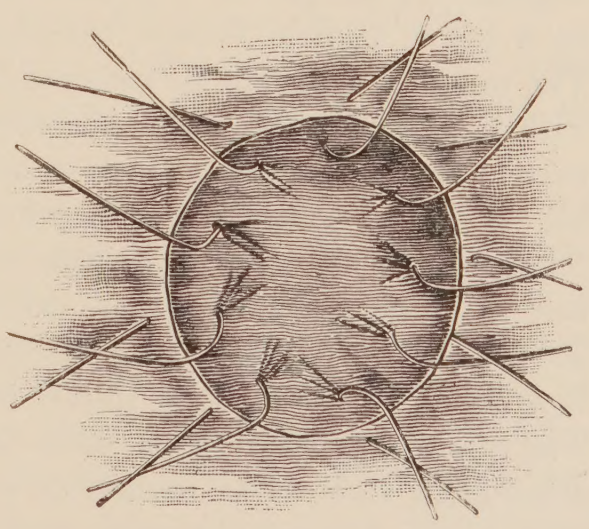
The patient may suffer from the mechanical effects of pressure of the tumor upon the urethra, bladder, or rectum. The presence of cysts in the vagina may also mechanically interfere with labor, menstruation, and coitus. Palpation will reveal that the tumor has a definite outline, that it is elastic and fluctuating, and that the mucous membrane usually glides freely over it. When the anterior vaginal wall is involved, the outlines of the tumor can ordinarily be made out by conjoined manipulation with the finger in the vagina and a sound in the rectum. When the tumor occurs in the posterior vaginal wall, it can be outlined by placing one fore finger in the vagina and the other in the rectum. The positive diagnosis must of course be made by aspiration of the cysts with a hypodermic needle.

Cysts of the vagina may be treated by—

a. Aspiration and the injection of a few drops of some irritant fluid, such as tincture of iodine, to promote adhesive inflammation.

b. Incision of the tumor, evacuation of its contents, and cauterization of the cavity by means of fused nitrate of silver or carbolic acid. Good results may follow the application of Churchill's tincture of iodine.

FIG. 29.



c. Excision of a part or all of the tumor. When the entire mass has been removed the wound may be closed with sutures. Schroeder[1] recommends the removal with scissors of that part of the tumor which projects into the vagina, and the union of the vaginal mucous membrane to the lining membrane of the cysts by sutures. The mucous membrane should be removed from the surfaces to be

[1] *Zeitschrift für Geburtshülfe und Gynäkologie*, 1878, iii. 424.

coaptated. By this means recurrence of the cyst will be prevented.

Gaseous Cysts are described by Winckel.[1] They may occur during pregnancy in large numbers over small areas of the vagina. Upon puncture they collapse with a distinct sound. Gaseous cysts are rare, are of no practical importance, and therefore require no further consideration.

Fibroma of the vagina is rare. Breisky[2] has been able to find only thirty-seven cases on record. Fibromata vary in size from that of a pea to that of a child's head, and are usually flattened by pressure of the anterior and posterior vaginal walls. They are more common upon the anterior vaginal wall. The relative amount of fibrous and unstriped muscular tissue in the tumor is variable, but, as a rule, the fibrous tissue predominates. The tumor may be pedunculated or sessile. The pedicle may be so long as to allow the tumor to protrude through the vulvar orifice. Pressure or tension of the pedicle may cause sloughing of the tumor. The tumor does not degenerate into carcinoma or sarcoma (Winckel).[3] When the growth is large the patient may suffer from pressure of the tumor upon the urethra, bladder, rectum, or uterus, and from obstruction to the vaginal canal, which may interfere with labor, menstruation, and coitus. The growth of the tumor is more rapid during gestation.

The diagnosis of fibroid tumors of the vagina is easy when the pedicle can be made out. The character of the tumor may be ascertained by conjoined manipulation between the vagina and bladder or the vagina and rectum.

The treatment consists in the removal of the tumor when practicable. Especial care should be taken to cleanse and disinfect the vagina. If the growth is pedunculated, the pedicle should be crushed by a heavy pedicle forceps, transfixed, and ligated with strong silk. The tumor should now be removed, and the stump, if large, cauterized with the Paquelin or galvano-cautery. If the tumor is sessile, the sac may be incised and the growth enucleated. All hæmorrhage from the sac should be controlled by ligation or forci-pressure. The walls of the cavity should now be painted with a mixture of Churchill's tincture of iodine and 95 per cent. carbolic acid, equal parts. The cavity should be firmly packed with iodoform gauze and the vagina carefully tamponed. The dressings should be changed after twenty-four hours. The tumor may be so large as to be an obstruction to labor, and its attachment such as to render its removal difficult or dangerous. In such a case Cæsarean section would be necessary (Winckel).[4]

"**Papilloma** of the vagina consists in an alteration of the mucous

[1] *Op. cit.*, p. 140. [2] *Cyclopædia of Obstetrics and Gynæcology*, vol. x. p. 347.
[3] *Op. cit.*, p. 154. [4] *Op. cit.*, p. 156.

membrane, whereby the papillary elements become greatly hypertrophied. It is found most frequently to affect the vagina just within the vestibule, but I have also found it on the nymphæ, and the area affected is generally not very large. It appears red and velvety, bleeding easily, and it is exquisitely tender to the touch. If carefully dried its nature can be recognized by the minute finger-like processes into which the papillæ have become elongated. If a piece be removed and examined by the microscope, it will be found that the inner structures of the papillæ are chiefly affected, the connective-tissue stroma, the nerve-fibres, and the vessels being all thickened, while the epithelial covering appears to be quite normal. The papillæ are not only elongated and thickened, but they become branched and even dendritic. The chief symptom, pain, is clearly due to the pathological changes, and it is often so acute as to render the patient's life a burden to her. I have seen many cases of papilloma set down as vaginismus. The disease may occur at any age, and can be treated effectually only by complete removal, either by caustics, such as the red-hot iron, perchloride of antimony, or a saturated solution of chromic acid, or, better still, by the use of sharp-curved scissors" (Tait).

Lipoma of the vagina is of extremely rare occurrence. Pelletan[1] has reported two cases in which he removed lipomata from the recto-vaginal septum. Conrad[2] has also written upon this subject.

Condyloma.—See Condyloma of the Vulva.

Tuberculosis of the vagina is rarely met with. Zweigbaum[3] has been able to collect only twenty-nine cases from the literature of the subject. Tuberculosis may be primary or secondary. Barbier[4] states that the primary form may result from bacilli in the seminal fluid or in the discharge from tubercular epididymitis. In the secondary form the disease may extend from the vulva to the vagina, and the germs may penetrate the vaginal walls from the bowel or bladder.

Local treatment is of little avail in tuberculosis. The chief object of all treatment should be to improve the general condition of the patient.

Carcinoma.—Primary carcinoma of the vagina is of very rare occurrence as compared with carcinoma of the cervix uteri. Biegel[5] observed only 14 cases of carcinoma of the vagina in 8287 cases of carcinoma of the uterus and vagina. Küstner[6] could find only 28 cases recorded in the entire literature of the subject. The disease may extend almost imperceptibly or may rapidly involve the entire vagina. The pelvic and inguinal glands are early affected. The disease may not be detected until ulceration has commenced, when hæmorrhage

[1] Winckel, p. 158.
[2] *Centralblatt für Gynäkologie*, xii. S. 214.
[3] *Brit. Med. Journ.*, 1889, No. 1, p. 93.
[4] *Gazette médicale*, No. 39, 1888.
[5] Hart and Barbour, p. 535.
[6] *Archiv für Gynäkologie*, Band ix. S. 279.

may occur from involvement of the blood-vessels, from coition, examination, etc. The discharge may be abundant and is always offensive. When the ulceration and infiltration become extensive, pain will be severe, but it seldom occurs in the early stage of the disease. Itching of the vagina and vulva is present as a result of the acrid discharge. The ulceration may extend into the bladder and form a vesico-vaginal fistula, or into the rectum and form a recto-vaginal fistula, or it may extend into the pelvic cavity and result in fatal peritonitis.

The treatment consists in the early extirpation of the entire diseased area. The resulting wound should be entirely or partially closed by sutures. A dry iodoform dressing should be kept in the vagina until union occurs, because this is probably the best antiseptic for such wounds and because it keeps the wound-surface dry.

Sarcoma of the vagina may occur in early life. A few cases are on record of its occurrence during childhood. The growth may be diffuse or circumscribed. Hæmorrhage and offensive discharges will occur when necrotic changes have taken place in the tumor. The growth of the disease is rapid. A positive diagnosis can be made only by a microscopic examination of a portion of the growth.

The treatment is the same as that of carcinoma of the vagina.

Leucorrhœa.

Leucorrhœa is the term applied to all watery, mucous, and purulent discharges from the female genitalia. It should not be regarded as a distinct disease. It is invariably a symptom of some definite pathological condition of the vulva, vagina, uterus, or Fallopian tubes. Leucorrhœa may therefore be classified as vulvar; vaginal; uterine, including cervical and corporeal; and tubal.

Vulvar Leucorrhœa.—The discharge in this variety of leucorrhœa is viscid, whitish or yellowish, acid in reaction, and becomes inspissated and glues the labia together. Upon microscopical examination it is seen to contain broken-down epithelial cells, pus-corpuscles, and occasionally blood-corpuscles. The discharge usually comes from the vulvar glands, but it may come from the glands of Bartholini or from portions of the vulva which have been deprived of epithelium. Before puberty the discharge comes chiefly from the Bartholinian glands. Leucorrhœa of the vulva is always a symptom of inflammation, congestion, œdema, or abrasions of the vulva, or of inflammation of the vulvar glands. The causes of inflammation of the vulva and its glands have already been considered. Congestion and œdema may result from pregnancy, subinvolution, menstruation, and excessive excitation of the vulva from frequent coitus, masturbation, etc. Abrasions may be a result of friction, acrid discharges, malignant disease, lupus, tubercu-

losis, and trauma: scrofulosis and anæmia predispose to vulvar leucorrhœa.

The treatment consists, first, in the removal of the cause, and, second, in the cure if possible of the local lesion. Cod-liver oil, iron, tonics, and the like should be administered according to the indications, and the hygiene of the patient should receive most careful attention. The vulva should be kept as free as possible from discharges; abrasions should be treated as described under Vulvitis, and the secretion of the glands should be diminished by the use of astringent washes, such as alum, sulphate of zinc, and colorless pinus Canadensis.

Vaginal Leucorrhœa.—The discharge in leucorrhœa of the vagina is watery, opaque, whitish, often resembling curdled milk, and is acid in reaction. The watery character of the discharge is due to the almost entire absence of mucous glands in the vagina. If the color of the discharge be yellow, it is due to the presence of pus. The curdled appearance is due to the mixture of the alkaline secretion of the uterus with the acid secretion of the vagina. The source of the discharge is usually the vaginal mucous membrane, but it may come from ulcerations and erosions of the vagina. Leucorrhœa of the vagina is a result of vaginitis, congestion, œdema, or abrasions of the vagina. The congestion and œdema may be due to pregnancy, subinvolution, or to anything which interferes with the pelvic circulation, such as displacements of the uterus, pelvic inflammations, or pelvic growths.

The cause of the discharge should be removed if possible. Everything which tends to produce hyperæmia of the vagina, such as excessive coitus, dancing, fatigue from standing or walking, constipation, tight lacing, etc., should be avoided. When the discharge is excessive during pregnancy, warm astringent vaginal douches may be employed, as, for instance, solution of alum, 2 ounces to the pint; sulphate of zinc, 5 per cent.; nitrate of silver, $\frac{1}{2}$ of 1 per cent.; colorless pinus Canadensis, 2 drachms to the pint; or chlorate of potassium, $\frac{1}{2}$ ounce to the pint. Glycerite of tannin or insufflations of boric acid, oxide of zinc, or aristol may also be used. Subinvolution should be treated as described elsewhere. The treatment of ulcerations and erosions of the vagina has already been discussed under Vaginitis and Malignant Disease.

Uterine Leucorrhœa.—CERVICAL LEUCORRHŒA.—The discharge is glairy, tenacious, mucous, resembles the white of egg, and is alkaline in reaction. Under the microscope it is seen to contain broken-down epithelial cells which may be ciliated. The discharge may be yellowish from admixture of pus. It may result from erosions due to ectropion or destruction of the epithelium from friction, acrid discharges, glandular degeneration, endocervicitis, œdema, or malignant disease.

The congestion and œdema may be due to pregnancy, subinvolution, displacements, pelvic inflammation, and pelvic growths.

The treatment consists in the removal of the cause of the symptom. The secretion in the cervical canal may be removed by the local application of acetic acid. For the cure of cervical leucorrhœa, however, it may be necessary to dilate thoroughly and curette under ether. The curettement should be sufficiently thorough to include all the diseased glands. The cervical canal should then be painted with a mixture of equal parts of Churchill's tincture of iodine and carbolic acid.

Corporeal Leucorrhœa.—The leucorrhœal discharge from the body of the uterus may be watery or mucous. It is opaque, alkaline, and may contain pus. Its source is the glandular endometrium, and it is a result of endometritis, congestion, œdema, hyperplasia, or malignant disease. Endometritis is due to retained portions of the placenta or membranes, to retention of the normal secretions of the uterus from flexion or stenosis, or to infection carried into the uterus. The congestion, œdema, and hyperplasia may result from subinvolution or displacements of the uterus, from pelvic tumors, or from pelvic inflammation. The malignant disease may be carcinoma or sarcoma. Uterine polypi will cause leucorrhœa by the congestion, œdema, and hyperplasia which they produce.

Corporeal leucorrhœa should not, as a rule, be treated until everything which might have caused it has been removed. Retained portions of the placenta or membranes should be removed in the following manner: The usual preparations having been made and no contraindications for the operation being present, the patient is anæsthetized, and the uterine cavity irrigated with hot sterilized water by means of a fountain syringe and return-current catheter. The cervix is now slowly but thoroughly dilated by a Palmer's, Goodell's, Wathen's, or other steel dilator, and the uterine cavity thoroughly scraped with Thomas's dull wire or Simon's spoon curette. The affected portion is again irrigated with hot sterilized water, carefully dried, and painted with the iodine and carbolic-acid mixture. If the uterus be flexed, thorough drainage should be established by packing the uterine cavity with strips of iodoform gauze, which should be renewed or changed according to indications, but may be allowed to remain three or four days. All retained secretions should be evacuated and free drainage established. The generally accepted idea that the uterus is an efficient natural drainage-tube is fallacious, for it has frequently been observed that secretions are pent up within the uterine cavity. Drainage may be secured by means of rubber drainage-tubes, but these are apt to become occluded from flexure or compression. Many drains have been devised made from hard rubber, glass, or metals, but their use is so often followed by serious symptoms that it is unjustifiable to employ them.

Outerbridge has devised a wire intra-uterine stem-pessary, but this instrument soon becomes buried in the cervical tissue. Even if this does not occur, the instrument is not strong enough to keep the contractile walls of the uterus separated. Absorbent gauze seems to be the only sure and safe intra-uterine drain. After thorough dilatation of the cervix in narcosis, a roll of gauze may be carried through the internal os into the uterine cavity, which has previously been packed with strips of iodoform gauze if indicated. The gauze may be allowed to remain in the uterine cavity for three or four days. If the uterus should contract so as to interfere with the capillary drainage of the gauze, the cervix may be dilated as often as indicated. This does not cause much pain. If pelvic inflammation exist, any intra-uterine manipulation is contraindicated and dangerous. The routine intra-uterine office treatment for leucorrhœa is meddlesome gynæcology, and usually does more harm than good.

Tubal Leucorrhœa.—Tubal leucorrhœa is usually purulent, but may be mucous or watery. The secretion collects in and distends the tube, which discharges its contents through the uterus. The patient suffers more or less severe pain during the distension and emptying of the tube. Great relief usually follows the paroxysmal discharge. The distended tube may be detected by the touch, but after the discharge the tube is collapsed and cannot easily be made out. When removal of the diseased tube is not indicated, drainage through the uterine cavity should be facilitated by keeping the cervix moderately dilated, and by the use of the gauze drain if flexion or stenosis of the uterine canal exists. The discharge of a pelvic abscess through the vagina should not be mistaken for leucorrhœa. Leucorrhœa may occur during infancy or early childhood. Keating regards most cases as contagious, but not gonorrhœal. It may result from uncleanliness, injuries, worms, eruptions, the specific fevers, and usually obtains in pale and scrofulous subjects and in those who are predisposed to eczema.

In severe cases the patient should be anæsthetized and a thorough examination made. If any inflammation of the vagina or vulva exist, the affected area should be painted over with a solution of nitrate of silver, 20 grains to the ounce. The vagina should be kept clean by astringent injections. Powders of iodoform, bismuth, oxide of zinc, starch, or boric acid may be applied to the vagina by means of an insufflator. If insufflation is difficult, these remedies may be used in the form of vaginal suppositories.

Profuse watery leucorrhœa occasionally occurs at the menopause. It is a result of the congestion and œdema which sometimes obtain at this period. The treatment consists in the use of hot astringent douches or astringent applications. Of these, glycerite of tannin is probably the best.

DISEASES OF THE UTERUS.

By R. L. DICKINSON, M. D.

If the term Therapeutics were restricted to treatment by drugs, brief space could contain the therapy of uterine disorders. But the application of remedial measures outside of surgery proper is our modern definition, and we are coming more and more to a working belief that he is the best practitioner who has the keenest scent for unfavorable surroundings and hurtful habits—who is most thorough in his supervision of work and rest, of open-air exercise, clothing, diet, and sleep, of sloth and strain, and manner of living.

To be frank, let us admit that most gynæcologists shirk this troublesome half of their duty. Our local treatment is painstaking and persistent, our operative resources are varied and successful, but we let the general condition make shift on a tonic, a laxative, and a cursory warning about rest or exercise. And this is our only excuse: that the teachers of physical culture have not organized their science in a way that we can lay hold on; that the dress-reformers have not stated their conclusions in a form that we can use; that our gynæcological textbooks are wordy or indefinite; and that we can turn nowhere for clear and compact statements.

For the details of operations the reader will be referred to works devoted to the specialty, but the indications for each measure, medical or surgical, will be given with as much definiteness as possible. Several important remedial measures which apply to every chronic uterine disease will demand consideration before the individual diseases are considered.

Dress.

Is the correction of faults in dress an important part of the treatment of uterine disease?

The reasons for an affirmative answer are based on recent experimental researches by which certain facts seem well established that heretofore have largely been matters of opinion and prejudice.

1. The normal breathing of woman is like that of man—abdominal.[1]

[1] Mays, *Therap. Gaz.*, May, 1887; Kellogg, "Dress and Pelvic Disease," *Trans. Mich. State Med. Soc.*, 1888; and "Exercise in Pelvic Disease," *Trans. Amer. Assoc. Obstet. and Gyn.*, 1890; Wilberforce Smith, *Brit. Med. Journ.*, Oct. 11, 1890.

Waist-constriction changes the type of breathing to costal.[1]

2. The pelvic organs, normally, make a considerable excursion with each respiration.[2]

Waist-constriction in the upright position checks this motion almost entirely.[3]

3. Sitting or bending forward lessens intra-abdominal pressure.[4]

Waist-constriction in these positions greatly increases intra-abdominal pressure.[5]

4. The abdominal organs are displaced downward, sometimes to a marked degree, by the habit of lacing.

5. The uterus is displaced downward by the corset (.2 to .5 inch).

6. The pelvic floor is bulged downward by tight-lacing (average, .3 inch).

7. The circulation in the pelvis is rendered sluggish.

8. The capacity for in-door or out-door exercise is hampered.

Moreover, the capacity for chest-expansion has been shown to be diminished one-fifth with loose corsets,[6] and the abdominal wall is shown to suffer from atrophy of muscle and accumulation of fat.

I. *Abdominal respiration is essential to woman's health; clothing must be worn that does not restrict it.*

FIG. 30.

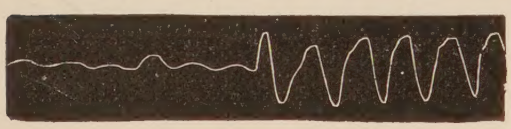


FIG. 31.

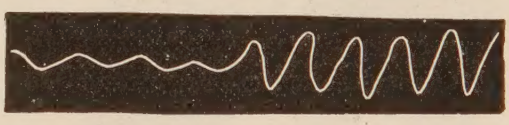


FIG. 32.

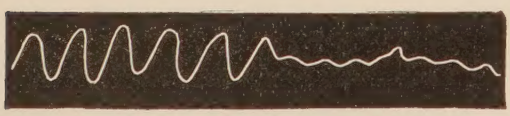


FIG. 33.

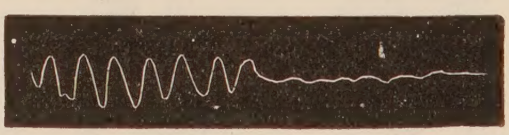


FIG. 30.—Respiratory Tracing, Man (Kellogg).

FIG. 31.—Tracing from a Woman who has always worn loose clothing. Note that it is almost identical with man's (Kellogg).

FIG. 32.—Respiratory Tracing, Woman in Corset (Kellogg).

FIG. 33.—Tracing, Man in Corset, resembling that of Woman in Corset (Kellogg).

All women who wear corsets and tight waist-bands, and most women who wear health-waists, breathe with a well-marked sternal movement.

[1] Gibson, *Med. Anat.*, p. 962; *Med.-Chir. Trans.*, 1848; Walshe, *Lond. Med. Times and Gaz.*, 1829; and Mays, Kellogg, Dickinson.

[2] Kellogg, Putnam-Jacobi.

[3] Kellogg, Dickinson.

[4] Schatz, *Arch. Gyn.*, iii. 58; iv. 193.

[5] Kellogg; Dickinson, "The Corset: Questions of Pressure and Displacement," *N. Y. Med. Journ.*, Nov. 5, 1887.

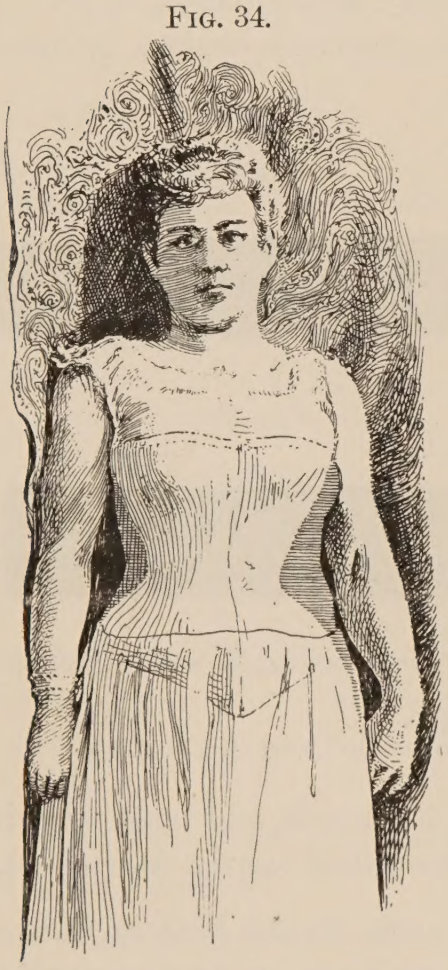
[6] See also Lennox Browne, *Voice, Song, and Speech*, Putnam, New York, containing Roberts's tables of breathing capacity and chest-girth in English women.

This costal or thoracic respiration is abnormal in woman as it is in men. Mays showed that Indian girls breathed like men, and Kellogg has confirmed the observation among various Indian tribes and among Chinese women, agricultural women, and English pit-brow lassies; and civilized women who have always been loosely clothed about the waist show the same type. Women asleep breathe like men, and male and female animals breathe alike. And the very argument that chest-breathing is normal to woman because it is necessary during gestation falls to the ground when it is shown that even late in pregnancy abdominal respiratory movements predominate over thoracic movements. The agent most active in abdominal breathing, the diaphragm, is a muscle that can be developed like any other muscle, so that long-distance runners in the quiescent condition have least costal breathing of all men.

II. *The constant to-and-fro motion of the pelvic organs is essential to their health. Clothing must permit this motion.*

With each movement of the diaphragm the structures of the pelvic floor and the organs above it are carried downward .1 to .3 inch, and up again, in the case of women who have worn clothing loose about the waist.

FIG. 34.

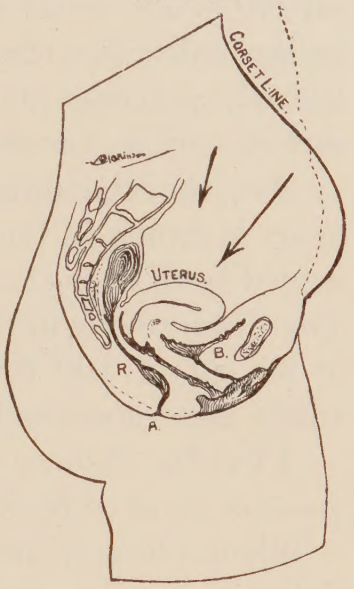


Girl in Corset and without Corset; an exact reproduction of a composite photograph. Note the two outlines at the waist.

Alternating pressure and relaxation secures free flow through the large venous plexuses and lymphatics; alternating traction and relaxation develops the muscular bundles of the uterine ligaments, of the peritoneal investment, and of the muscular pelvic floor; and alternate stretching and slackening strengthens elastic supports. As in any other part of the body, exercise is needed—rest and motion in right proportion—and the organs themselves need it as much as their supports and blood-vessels do. With each inspiration the descent of the diaphragm increases the pressure in the abdominal cavity, and lessens that in the chest; blood is squeezed out of the pelvic and portal veins, and at the same time sucked up above the diaphragm. Therefore, dress that cripples the diaphragm slows the pelvic circulation. The blood-flow is manifestly interfered with in another way. The valveless ovarian veins empty in the area of greatest corset pressure, giving a long and perpendicular column of blood to be dammed back.

But when the corset is worn, little or no motion can occur, because all the structures in the true pelvis are carried downward by the constant pressure, to the utmost of their ability to move in that direction. Coughing and vigorous straining at stool depress them but a trifle farther than a snug corset. The uterus cannot make its excursion of a tenth or a third of an inch with each respiration.

FIG. 35.



Action of the Corset in producing Anteflexion.

III. *The clothing must not displace the pelvic or abdominal organs.*

I have demonstrated[1] that the pressure from a tight corset, or from a loose corset with the wearer in a bent or stooping position, bulges the pelvic floor downward to the utmost limit of its capacity to yield. Kellogg and others have made the same observations. The uterus has been shown to be correspondingly depressed. Consequently, all its supports are stretched and keep tense for many hours daily, while any exertion or stooping strains these taut structures still farther. Therefore, in all varieties of pelvic inflammation corsets and waist-bands must come off and the skirts and drawers be hung from the shoulders. In anteflexion, which is often accom-

FIG. 36.

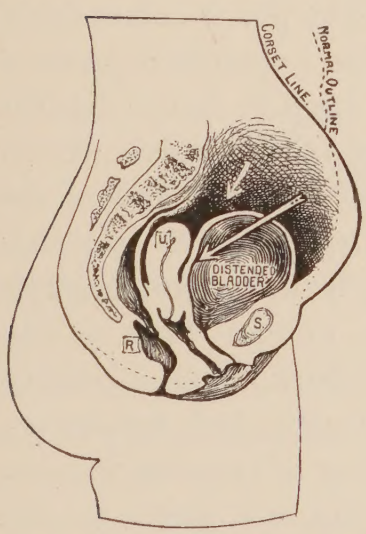


FIG. 37.

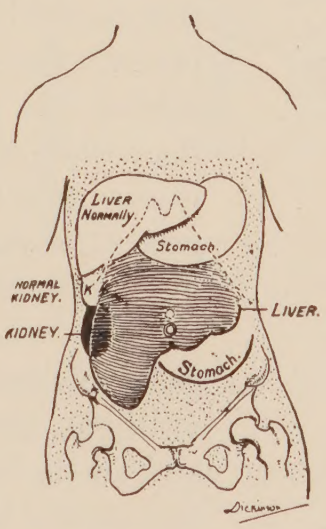


FIG. 38.

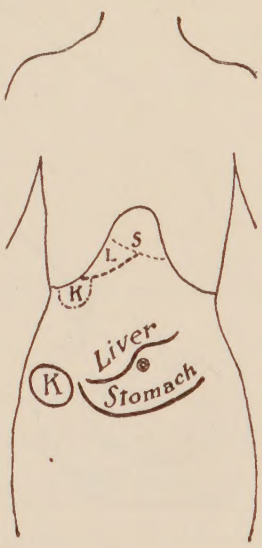


FIG. 36.—Action of the Corset in starting a Retroversion.
FIG. 37.—Displacement of Organs produced by Corset-wearing; from a patient.
FIG. 38.—Displacement of Organs due to a Health-waist (Kellogg).

panied by inflammation of the utero-sacral ligaments, the traction produced on the tender ligaments is especially dangerous. Moreover, the increased pressure from above flexes the uterus still farther when

[1] *N. Y. Med. Journ.*, Nov. 5, 1887.

the bladder is empty. A robust dressmaker came to me, measuring five inches less with corsets on than over her undershirt with corsets off. Her cervix and fundus met, so extreme was the bend. Without other treatment than removal of all constriction for three weeks the uterus straightened. In descent of any degree no increase in pressure from above can be permitted. In retroversion the pressure comes on the anterior surface of the uterus and forces the fundus backward. Indeed, whenever an over-full bladder tilts the organ abdominal pressure can act on the front face of it to tip it over backward.

Are the abdominal organs displaced by corset wearing? Testimony is strong in the affirmative, as shown by autopsies[1] and demonstrated by Kellogg's studies. The liver has been often found pushed a long distance downward, even to the iliac crests. One or both kidneys in 30 out of 100 cases examined by Kellogg (paper of September, 1890) were abnormally low.

IV. *The clothing must not increase abdominal pressure in the sitting position or when bending forward.*

When a loosely-dressed individual, who is seated, bends forward, the abdominal walls relax and intra-abdominal pressure is greatly reduced (Schatz). But in this position, in the case of a corseted woman, the steels press the lower part of the abdominal wall almost directly downward, and the pressure under these steels and in the abdomen increases, as shown by the gauge. The inclination of the pelvis is lessened by sitting, as shown in the cut—that is, the brim of the pelvis comes fairly beneath the abdomen; therefore pressure gets at the pelvic organs more directly than when the axis of the pelvic cavity is at a wide angle to the long axis of the general cavity of the trunk, as in standing; and all this is more emphatically the case when the woman "sits on the small of her back." Now, all seamstresses, milliners, straw-, carpet-, and fur-sewers, and all the large class of women who use the needle in the lap, are liable to this pressure. Then in a lesser degree those who bend forward at a table, such as stenographers, clerks, and sewing-machine operators, crowd their pelvic contents downward; so do servants also,

FIG. 39.

Girl bending Forward at Work The pelvic inclination is lessened, and the corset-steels readily depress the pelvic organs.

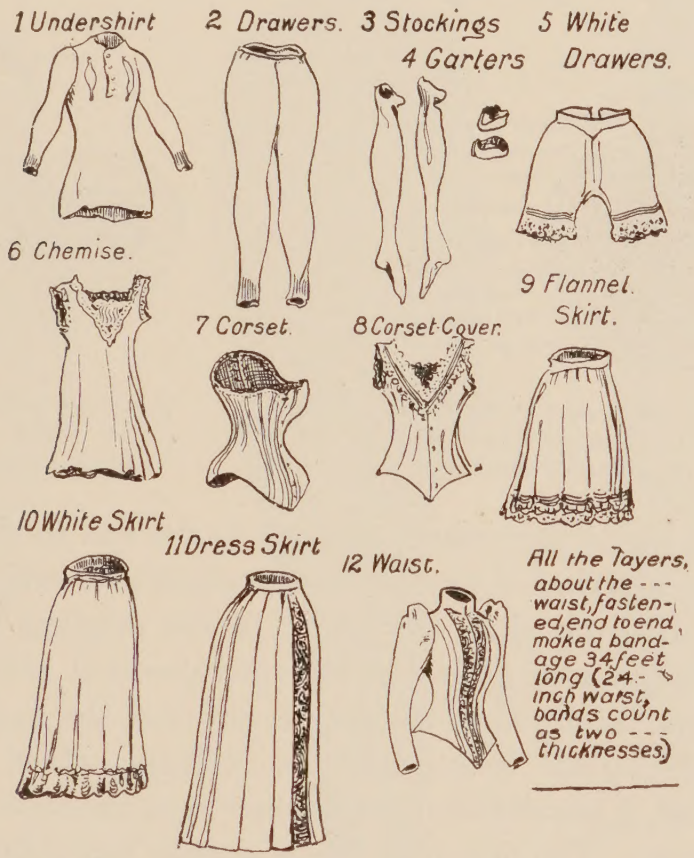
[1] Engel, *Wien. med. Wochenschr.*, 1860, p. 529; Frerichs; Murchison, *Diseases of the Liver;* Corbin, *Gaz. Med. Paris*, 1830; all quoted at some length in my paper on the corset.

stooping under strain. In patients of any of these classes suffering from pelvic disease the first step in treatment is to remove the constriction.

V. *Activity and exercise are essential to health. Clothing must be loose, light, and well hung in order not to hamper muscular action.*

The house-habits of women, the lack of participation in active sports among girls, the imperfect muscular development, and the sluggish peristalsis have an important effect in the ordinary methods of dress. "Look at a lot of girls on the way to gymnasium," said a Vassar teacher. "They drag along. They have no spirit or spring in them.

FIG. 40.



The Present Dress, consisting of twelve different articles—five hanging from the waist and four from the shoulders.

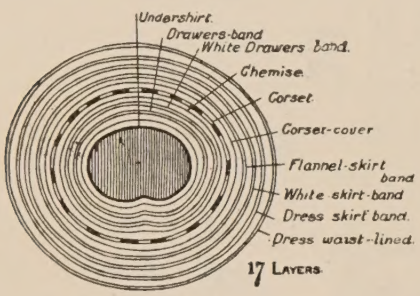
They are in their ordinary clothes. Look at the same set coming on to the gymnasium floor in their light toggery. They skip and dance and run in the liberty of their unrestrained and untrammelled motion. They are different beings."

To remove a corset and leave the individual to the constriction of her waist-bands is of little use, and to substitute a health-waist, such as the equipoise or Jenness-Miller, for the corset, leaving the heavy skirts to hang on the abdomen, buttoned to such a waist, is to make an improvement of relatively small value. Deformity of outline, displacement of organs, and increase of intrapelvic pressure remain. What such a change does is to remove the rigid steels, which are

the most harmful things about a corset. In some cases we may be forced to this measure as an entering wedge. Yet resort to it is rarely needed.

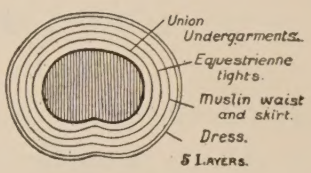
Hygienic Dress.—Against conservatism and prejudice and ridicule and indifference the reform has made good progress. Success has been due partly to the fact that manufacturers and dressmakers have been obliged to provide for the new demand, and because the leaders are preaching the beauty rather than the healthfulness of the change. "Tell my girls that tight-lacing will hurt their complexions," said a school-principal to me, "and you have a lever." Our other levers are desire to be free from pain, to bear children, to save the expense and the distastefulness of prolonged treatment.

Fig. 41.



The Seventeen Layers at the Waist-line in the Present Dress, each band being a double thickness.

Fig. 42.



The Five Layers in the New Dress (the dress having a lining).

It behooves us, as physicians, to move in the van in this reform and to guide it into practical channels—not to stand aside and damn it with faint praise. It is our duty to "cure" in the original sense—*curare*, to care for—the growing girls and the convalescents after childbed of our practice, and to do what we may to prevent the necessity, always deplorable, for vaginal treatment. In colleges, where the girls are readily reformed, a physical-culture teacher says the trouble lies chiefly with the mothers. The new clothing is simple, beautiful, light, warm, comfortable, and well hung. Moreover, it is within almost every woman's reach and is growing less expensive. As it is difficult for men to grasp the details of a dress, it has seemed best to picture the successive layers somewhat elaborately.

The four garments are—

1. Union under-garment, being an undershirt and drawers in one piece, made of Jaros material (wool inside, cotton backed)[1] or silk or wool or merino—desirable in the order given—for winter wear, high-necked, long-sleeved, and reaching to the ankles (Fig. 45). For summer wear, of silk or lightest wool or cotton or lisle thread, low-necked, short-sleeved, and reaching to the knee.

[1] An important new material, office No. 831 Broadway, N. Y. The loose wool, next the skin, remains warm and dry after passing a drenching sweat outward to the cotton.

2. Equestrienne tights, dark colored, jersey-fitting, reaching from waist to ankle, open at the crotch (Fig. 44.) These are not needed in summer, and are slipped on in winter before going out, and removed on returning. They replace the cumbersome flannel petticoat and the still heavier divided skirt.

FIG. 43. FIG. 44. FIG. 45.

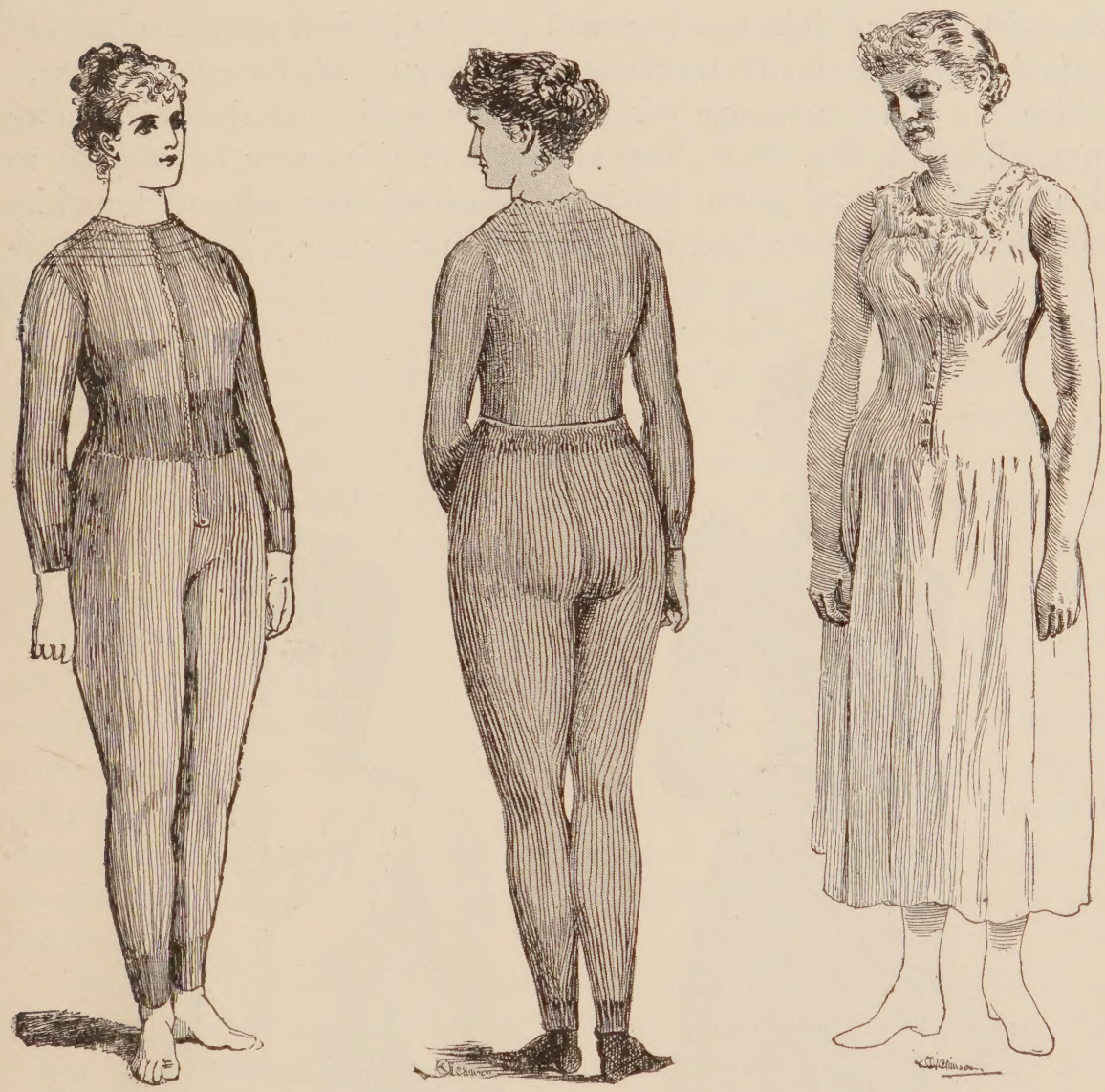


FIG. 43.—Union Under-garment. For summer wear it is made with low neck and short sleeves (Ypsilanti).

FIG. 44.—Equestrienne Tights, to be worn in winter.

FIG. 45.—Waist and Skirt in One Piece.

3. Muslin waist and skirt, in one piece (Fig. 45.) The waist prevents speedy soiling of the under-garment by dark dresses and dark linings and guards the dress from perspiration. The object of the skirt is twofold: First, to provide that flap with which the vulva comes in contact in sitting, inasmuch as a woman after urinating, on the verge of menstruation, or having even a trifling leucorrhœa, cannot risk any soiling of her dress, and particularly as a seated position tends to separate the labia; second, to render less conspicuous the shape of the legs in walking or in a wind, and to prevent their contour show-

ing as a woman stands in a thin dress skirt against a bright light. I admit the necessity of the waist and of the skirt also when wearing thin dresses; but the other need may be met by a generous (muslin) flap sewed on the back of the union undergarment. Such a flap on the under-garment is required if the tights are closed.

4. The dress hung from the shoulders. The designation "Princess" applies to a dress in one piece. Should a basque (bodice) be desired, the skirt, if very light (wash-goods), may be hooked upon the basque; but if heavy, it should be made on a Jenness-Miller "gown-form," which is a skeleton basque constructed by continuing the skirt-lining upward. (See Fig. 46.) The old style of skirt may be adapted to this idea by removing the band and stitching the lining of the skirt to a skeleton basque, which is made of lining muslin. Notice the large

FIG. 46.

Dress hanging from the Shoulders—the "Princess" principle.

FIG. 47.

The Jeanness-Miller Gown-form, which suspends the skirt from the shoulders—used when the skirt is separate from the basque.

armholes and low-cut neck and the broad bearing over the shoulders (Fig. 47). This broad bearing is important, since a woman cannot

wear suspenders, because her breasts push them outward and cause them to cut and chafe.

Notice chiefly that we have thus done away with bands, with weight carried on the hips and abdomen, and with the overlapping of upper and lower garments. The result is as great a gain in grace as it is in comfort, in speed of dressing, and in health. My converts have not relapsed.

As to cost. The first change is an expense, but the outfit is more economical in the end, and saves wash-bills. Moreover, these garments can be bought as men buy theirs, and save making at home.

As to fit. Slender bones in the seams keep the bodice trim, keep it from "that dreadful horizontal wrinkle" that is worse than wrinkles on the face. Women, like Ellen Terry or Sarah Bernhardt, who abjure stays, may wear loose or flowing drapery about the waist, and need to consider a snug fit less than stout ones. But women whose breasts are large or flabby need support for them in order not to look slouchy, and the Equipoise or Jenness-Miller waist may be recommended as the least objectionable substitute for corsets. Weak women, who really suffer persistently from backache after removal of corsets, may also require such a substitute for a time. But let it be noted that disuse of support develops firmness in the breasts, and that disuse of corsets develops an erectness in the figure that is due to the growth of the body-muscles consequent on the constant need of balancing, and that such erectness ensures clean lines in front. To all women whose corsets are removed we recommend out-door exercise or certain special exercises (p. 741) to develop the muscles of the trunk. We shall encounter our greatest difficulty with the dressmakers. A tight corset is what they can fit a dress over most easily, and they despise the new methods.

Stocking support. The harm done by garters is self-evident. A hose-supporter, like the Warren, that runs up to one of the garments hanging from the shoulders, is more comfortable and efficient than garters.

Muscular Exercise.

Exercise carefully prescribed is an exceedingly valuable means of treatment in a large class of pelvic diseases.

I am so strongly convinced of the paramount importance of this means of relief of suffering in pelvic disorders that I deem it advisable to devote considerable space to it. "I know of no means by which the general nervous irritability and pelvic pains and congestion of various sorts can be so certainly and permanently removed as by active and passive exercise judiciously administered."

"The comparative immunity from the disorders peculiar to their

sex, as well as from the pain and accidents connected with childbirth, enjoyed by savage and peasant-women may be largely attributed to their excellent muscular development;" and where, from lack of care and of skilful attendance, labor has given rise to extensive lacerations comparatively little suffering is caused by them. A German peasant-woman whose uterus hangs outside the vulva seeks relief less on account of pain than on account of mechanical inconvenience in walking and working. The English peasant in the brickmaking districts carries large masses of wet clay and tramps all day with cold, soaked feet during her menstrual period without injury or danger. So did Stanley's African porters. Yet civilized woman is injured by stair-climbing, by a jump, a fall, or the use of a sewing-machine. It is not that the exercise is too severe, but that her muscular development is so deficient that she is not able to bear trifling strains. The remedy does not consist in abolishing stairs, sewing-machines, and exercise, but rather in educating women, physically, to endurance and vigor.[1]

FIG. 48. FIG. 49.

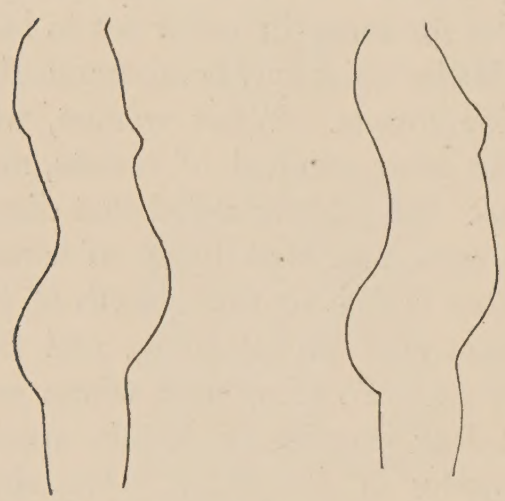


FIG. 48.—Results of Corset-wearing (Kellogg).

FIG. 49.—The same Patient after Three Months' Exercise (Kellogg).

To make patients persist in muscular work it must be supervised by well-trained teachers. There are a few energetic souls who are not discouraged by the irksomeness of a lonely course at home, but it is rarely kept up without the company of an enthusiastic friend. To be interesting, exercise must have an element of competition and sociability, as games have; moreover, it must be graded. It is as unwise to prescribe tennis for the ordinary city-girl as it is to allow boat-racing to the college-man. Either involves spurting and heart-strain unless carefully watched.

In summer there are many sports available, such as swimming, surf-bathing, rowing, archery, tennis, riding, and bicycling. Suitable dress must be insisted on. A blouse without a corset, and a skirt with no tight waist-band, and a bathing suit without sleeves or over-long skirt, are to be specified. In winter the gymnasium offers class-work and individual work—running, swimming, sparring, fencing. The semi-annual measurement, with chart, is an incentive to body-building, and permits of system and science in prescribing to develop symmetry. When a gymnasium is not at hand, it is not difficult, in these days when women are graduated from the

[1] Kellogg, who reports results of exercise in 8000 cases of pelvic disease.

physical-culture schools in considerable numbers, to find instructors for private classes at moderate rates. Six or eight girls can meet three times a week, get into costume, work half their time with light dumb-bells and with skipping ropes as an excellent substitute for a running track, and then take a lesson with gloves or foils. One- to two-pound dumb-bells, ropes, punching-bag, and gloves or foils cost little or may be rented from the teacher. The simplest costume is a loose flannel blouse, and wide Turkish trousers caught below the knee by an elastic band, but falling lower and looking like a skirt. (See Butterick's patterns.)

FIG. 50.

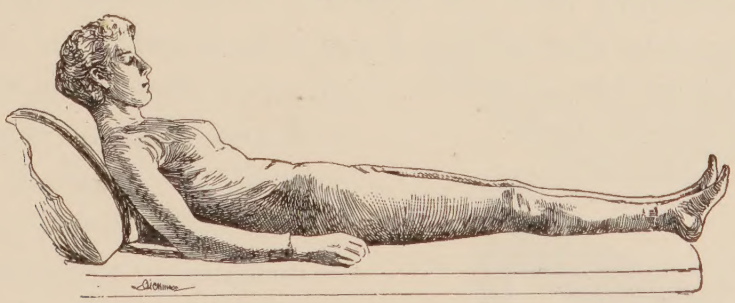
Gymnasium Suit.

To get thoroughly satisfactory results a gynæcologist should have a gymnasium of his own, as can be best done at a sanitarium or private hospital, or, in very simple fashion, in a private house. A good teacher is the main expense.

Special Exercise.—Each case requires a prescription suited to the individual needs. Here, for instance, are home exercises of a simple kind (suggested by W. L. Savage, M. D., of New York):

WEAK ABDOMINAL MUSCLES.—1*a*. Lying on the back in bed in the morning, raise the head and shoulders a few inches off the pillow,

FIG. 51.

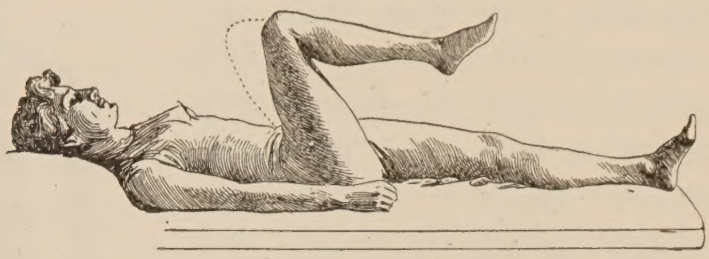


Exercise for the Abdominal Muscles.

then slowly lower (Fig. 51). Repeat and rest. Begin with five twos, gradually increase to five fives. After a few weeks, when this has grown easy, substitute 1*b*. Fix the feet against the footboard of the bed and rise to the sitting position, at first with pillow behind the back, later with none. Five fives slowly. 2*a*. Lying on the back, bring the bent knee as far toward the face as it will readily

go, then force it an inch or two farther (Fig. 52). Straighten the leg slowly; repeat with the other leg; five times with each. This is much easier than 2*b*. Later, substitute 2*b*. Lying on the back,

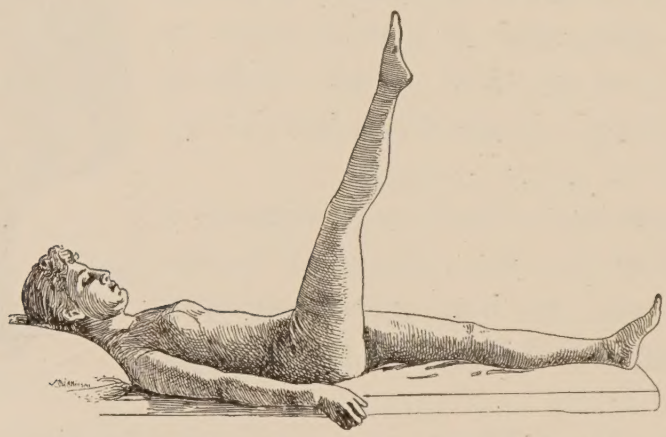
FIG. 52.



Exercise for the Abdominal Muscles and the Thigh Flexors.

raise the legs from horizontal to perpendicular, slowly in alternation (Fig. 53). Ten times each. 3. Lying on the back, place a weight,

FIG. 53.

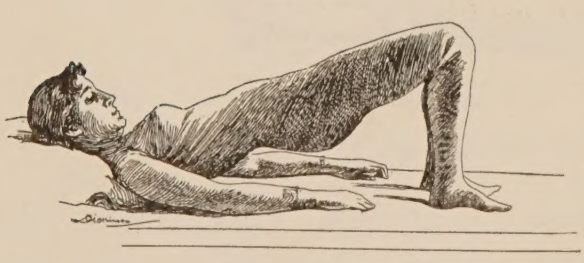


Exercise for the Abdominal and Thigh Muscles.

such as a flatiron, sand-bag, or heavy book, on the abdomen. By deep abdominal breathing raise the object as many inches as possible, hold it up a few seconds, then slowly lower it by expiration.

WEAK BACK MUSCLES.—1. Lying on the back, with the feet drawn up, the hips are raised until the thigh is in line with the body, held a moment, and dropped; rest; repeat five to ten times (Fig. 54). 2. Lying full length on the abdomen, with arms along the sides, breathe deeply, then raise the head and shoulders clear of the bed, hold still a moment, and slowly lower. Rest. Repeat five to ten times (Fig. 55). When all these become easy a severer task may be given, such as 3. Lifting the body off the bed, resting

FIG. 54.



Exercise for the Back Muscles.

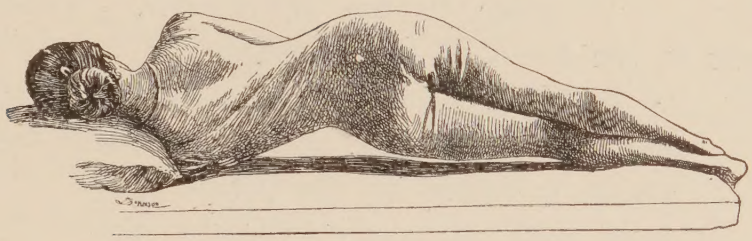
on the elbows and toes. Rest; repeat three to five times, with a

FIG. 55.

Exercise for the Back Muscles.

rest between each. The same purpose is effected by the "Amenorrhœa Exercises."

FIG. 56.

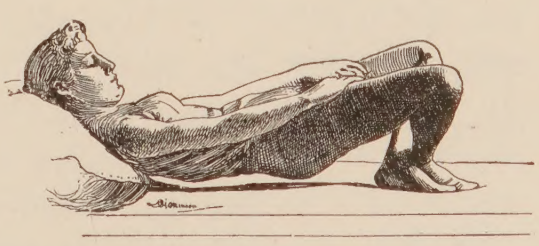


Exercise for the Lateral Trunk Muscles.

WEAK LEVATOR ANI AND RELAXED PELVIC FLOOR.—1. The patient is taught to contract the levator and draw up the pelvic floor by a motion such as one would practise to retain wind or a thin passage, drawing back abdominal wall by deep breathing at the same time, standing against a wall or sitting. Five threes.

2. Lying on the back, feet drawn up and crossed; buttocks are raised; then knees are slowly opened wide against her own resistance (Fig. 57). Repeat two to ten times. 3. Knee-chest position. Patient takes deep abdominal breath, then expels it by contracting the belly muscles forcibly, at the same time drawing up as strongly as possible the muscles of the pelvic floor.

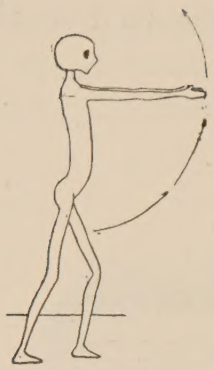
FIG. 57.

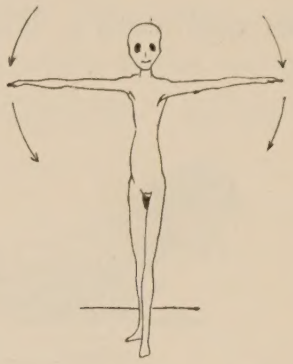


Exercise for the Levator Ani and Adductors.

Note that many of these exercises are in such positions that the pelvic organs are not forced downward during the practice, and yet play freely.

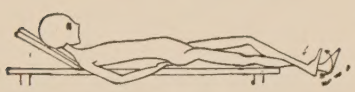
Muscular Exercises for Amenorrhœa—that of anteflexion, for instance (Brandt's selection, with drawings copied from Jentzer and Bourcart).—1. With one foot forward a deep breath is drawn and the arms are elevated above the head, parallel, in front, with palms facing



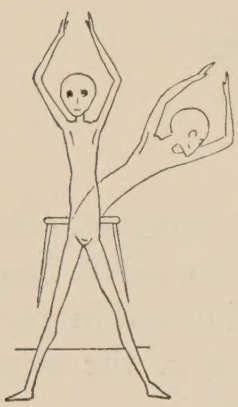


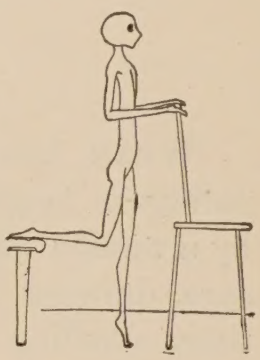
inward; then, during expiration, they are brought down laterally with palms facing downward. Slowly, five times.

2. Lying on the back with the lower extremities unsupported and the legs crossed, the toes execute circles from within outward, the movement taking place in the ankle-joint. Reverse legs and repeat. Eight to ten times in each position.



3. Upright, with feet well apart, buttocks resting against a table and arms above the head; the trunk is flexed on the pelvis sidewise and forward. Slowly five times to each side, pausing between each motion.

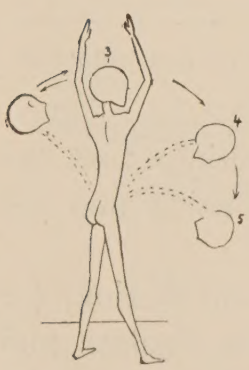




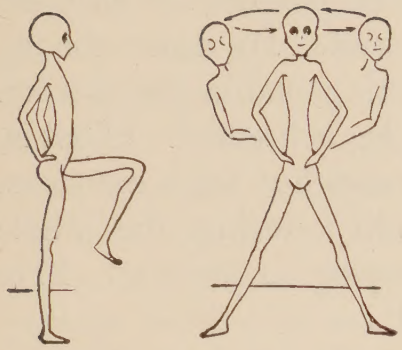
4. With hands on the back of a chair, one foot upon another chair behind her, the patient rises on the toes of the other foot, then drops toward the ground by bending the knees, then resumes the extended position on the toes, finally dropping on her heel as before starting. Slowly, alternating, five with each foot.

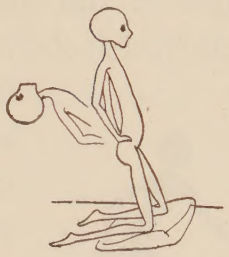
5. Upright, with feet apart and arms elevated, the body is bent forward, then backward, then pauses in the upright position. Five times each.

6. Resting a hand on the back of a chair before her and standing on the leg of the same side, the other leg is raised, and the knee executes movements of rotation from within outward. Reverse legs.



7. With hands on the hips and body well back, a running motion is executed, remaining in the same spot, bringing the thighs up to a level with each step. Ten times rapidly, then three or four times with an interval between each. This sends the blood to the pelvis strongly.





8. Standing with feet apart and the hands on the hips, the head describes a circle. Five times in each direction.

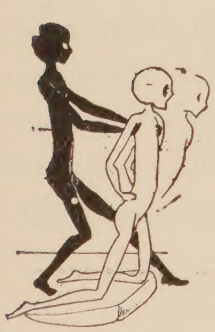
9. Kneeling on a cushion with knees apart, the body is bent backward and returns slowly to the perpendicular. Five to seven times.

One example of an efficient passive motion may be given:

10. The patient semi-recumbent; the gymnast lifts one leg by a hand in the popliteal space and the other on the sole. The thigh is flexed on the abdomen, carrying the knee outward, describing a small circle, repeating the motion ten times, while increasing the rapidity of it; after a pause he begins again, and so on, thirty to forty movements being given to each leg, while the patient remains absolutely relaxed. This may be followed by flexion and extension against resistance.

Muscular Exercises for Metrorrhagia (Brandt).—1. The patient sits facing the doctor (or nurse), hands on the hips, knees apart. The operator, placing a hand on the patient's shoulder and one under the opposite armpit, draws her forward while twisting the body on the pelvis. The patient resists the forward motion, the gymnast resists the backward one. Six times for each side. Then directly forward, bending and straightening, the patient always keeping the back muscles tense.

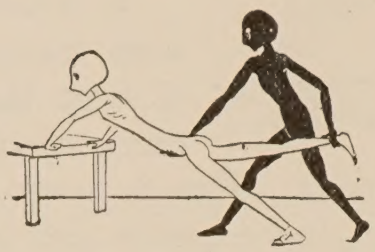
2. The patient kneels, hands on hips. The gymnast places his knee against her buttock and his hands under her armpits. She bends forward while he resists, and he draws her upright while she resists. While she is bent forward he twists the body above the pelvis rapidly several times. Rest between each. Five repetitions.



3. The patient stands in a doorway with hands high up against the door-jambs. The gymnast places one hand on the abdomen and the other between the shoulder-blades and pushes her forward. As she regains position he resists slightly, slipping his hand upward. Ten repetitions.

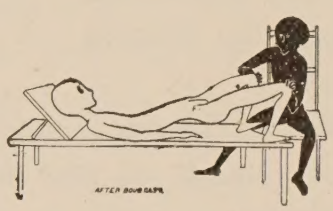
4. With her back against a wall and hands on hips, the patient

places an ankle in the gymnast's hand, while he steadies her with his other hand against the iliac crest. He draws the leg upward and outward, she resisting, and he resists when the leg is lowered. (That is, she uses her thigh-extensors steadily during the whole pumping motion.) Five each.



5. The patient is strongly inclined forward, leaning against a chair or bed-post. With one hand under the abdomen the foot is lifted by the gymnast, the patient remaining passive; then as he depresses the leg she resists. Five repetitions on each side.

6. The patient leans far forward, resting her hands against a wall at the level of the chest, with elbows turned out, feet apart, abdomen prominent. The gymnast places one hand under the abdomen, and with the knuckles of the other half-closed hand he taps lightly on the sacrum and lumbar vertebræ.

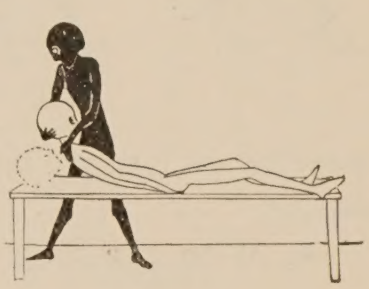


7. The patient, recumbent, draws the feet together under the bent knees and lifts her hips clear of the couch. The gymnast resists when she attempts to draw the knees together. Repeated five times. Then he resists while she draws her knees apart. Between the exercises she rests. This is said to act strongly on the levator.

For patients too weak to rise the following samples for a prescription are given:

8. The gymnast stands at the head of the bed. The patient, with head supported and knees bent, reaches her hands up to him, with elbows slightly bent. Then he moves the arms at the shoulder-joint, making circling motions forward, downward, backward, and upward, while she lies passive. Subsequently she bends and straightens her arms, he resisting flexion, she extension.

9. The patient lying flat on the back, with legs extended, the physician (or nurse) places one hand on the occiput, the other on the nape of the neck, with fingers reaching down the back, and raises her a short

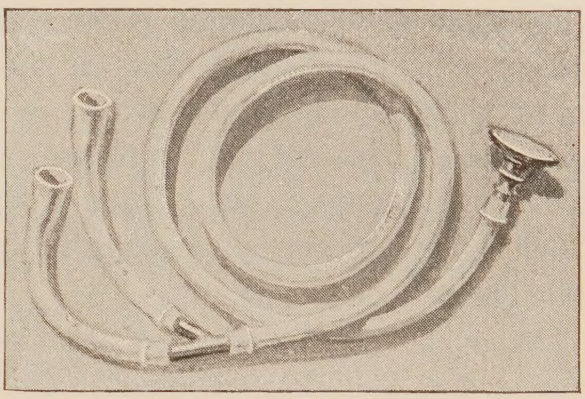


distance while she resists. As she drops back he resists. It is useless to bend the body very far.

10. Knee-resistance without lifting the hips from the bed.

Cold Water is an efficient and inexpensive tonic which needs regulation in dosage, and its use requires detailed instruction. With patients who do not react the skin may be cajoled at first by an alcohol rub, immediately followed by an oil rub, changing later to a tepid sponge bath with sea-salt, and later still to a tepid spray, until gradually we may come to cold water, followed by a rub-down with a coarse towel. If the patient sleeps poorly or still reacts somewhat imperfectly, just before going to bed is the best time for cold water. A most comfortable and efficient device is made of a rose-nozzle and five feet of rubber tubing with a forked end that permits of attachment to both bath-tub faucets, in order that the temperature of the water may be regulated. Any rubber store supplies this at $1.50 to $2.

FIG. 58.



Spray for Attachment to the Bath-tub Faucets.

GYNÆCOLOGICAL GYMNASTICS AND MASSAGE OF THE PELVIC ORGANS.

During thirty years the work of Thure Brandt has been battling for recognition against professional prejudice, until the brilliance of his results and the permanence of thousands of cures are winning sure foothold for his teaching as an important part of gynæcological therapeutics.

Briefly, his method consists in kneading, with a hand on the hypogastrium, the pelvic organs and tissues lifted up within reach by a stationary finger in the vagina, and in "lifting the uterus," together with many Swedish movements. In keenness of diagnostic skill, in thoroughness of investigation, and in gentleness and patience in treatment, it is said that we have much to learn from this layman. High authority assures us that under his skilful hands exudates and recent adhesions disappear in a short time, fixed ovaries or retroverted uteri soon return to place, and prolapse finds a most valuable remedy. Among the Germans it has been warmly endorsed by Schultze, Profanter,[1] Von Preuschen,[2] Schauta,[3] and Resch.[4] Resch has translated

[1] "Massage," *Gynecol. Wien*, 1887, abstracted in *Am. Journal Obst.*, Nov., 1890.

[2] *Cent. Gyn.*, 1888, No 13; *Berl. klin. Woch.*, 28, p. 117.

[3] *Prag. med. Woch.*, 1887, No. 43.

[4] *Cent. Gyn.*, 1887, No. 32.

Brandt's book into German.[1] Lindblom[2] and Landau[3] have made valuable contributions. Jentzer and Bourcart of Geneva have just issued a monograph of 160 pages[4] which covers the ground fully, and is the first clear, detailed, and fully illustrated work on the subject, reviewing the entire scattered literature and revised by Brandt. By its publication these weighty reasons for the lack of popularity of Brandt's methods will be overcome: namely, the absence of a text-book with illustrations and exact and careful instructions. I shall endeavor to have it translated.

Indications.—Chronic inflammation of the tissues of the pelvis, with or without displacement of the uterus; displacement and fixation of ovaries; chronic ovaritis; relaxation of muscular tissues and their results, descent and prolapse; and hæmatocele (?) (Resch).

Contraindications.—Acute inflammation; gonorrhœal infection; a high degree of nervous excitability (sexual); and very fat abdominal walls (Resch).

Objections.—Danger of exciting sexual feeling; difficulty of learning the method; expense of the treatment; risk of injury when careful diagnosis is not made; the American's demand for quick relief.

Massage.—For these reasons it would seem advisable to restrict intravaginal massage to cases of prolapsus uteri, adhesions, exudates, and displacements which are not relieved by ordinary means short of operation. It would seem to be rarely advisable among young unmarried women, and Brandt is very reserved about such use of it.

One of the strong points about methods of pelvic massage is that they greatly facilitate diagnosis. Gradual action on the resisting structures relaxes them to such an extent that the fingers reach what ordinary examination does not reveal. Brandt first examines all patients standing, because the organs are within easier reach and because the dorsal position sometimes produces retroversion. He examines them per rectum, and finally lets the patient lie down, with shoulders and head elevated. When he is examining the left inguinal region he asks the patient to lift the left hip moderately, and *vice versâ*, in order to let the mass of intestines slide away, or she may be asked to lift her hips clear of the couch, further to relax her abdominal muscles. If the examination has been painful or exciting, he compresses the perineal branch of the pudic nerve by pressure with the fingers outward on each side of the anus and perineal body against the ascending ramus of the ischium.

Acute Endometritis.

Occurring ofter exposure or excess during menstruation or from

[1] *Thure Brandt's Heilgymnastische Behandlung Weiblicher Unterleibskrankheiten*, Wien, 1888, Braumüller.

[2] *Münch. med. Woch.*, 1888, 46, 47, 48. [3] *Therap. Monatshefte*, Juli, 180.

[4] *Gymnastique gynécologique*, Genéve, H. Georg, 1891.

gonorrhœal infection (exclusive of the septic form following labor, which is considered elsewhere), the treatment of acute endometritis is simple. Rest in bed, hot applications over the abdomen, and sufficient opium and belladonna, in suppository, to relieve pain, are ordered.

℞ Morphinæ sulphat., gr. j;
Ext. belladonnæ, gr. j;
Olei theobrom., q. s.
M. et ft. suppositoria No. 4.
Sig. One to be passed into rectum to relieve pain; repeated in an hour if required.

The bowels should be unloaded by an enema. Ergot may be required if the flow is excessive, but moderate bleeding diminishes the distress. When all active symptoms have subsided, iodine to the lower abdomen daily and to the cervix and vaginal vault every fourth day, hot vaginal injections twice daily, and glycerin tampons every fourth day, hasten convalescence.

Chronic Cervical Endometritis (Chronic Catarrh of the Cervix).

The Treatment of Causes.—Before considering the special treatment of cervical catarrh we must deal with the conditions that occasion or aggravate it, of which the chief are laceration, displacements, gonorrhœa, sexual abuses, adjacent inflammations, and the patient's general condition.

1. Laceration of the Cervix.—Injury during labor or abortion is the commonest cause. It is always to be looked for, and is frequently marked by the thickening of the everted lips or by their rolling outward. A tenaculum fixed in each to draw the two together will show what their original relation must have been. In recent cases it is not difficult to bring the surfaces into healthy condition, but the relief is not permanent. In cases of long standing the care must be prolonged, and in either case permanent cure will result from suturing alone. To prepare for the operation it is advisable to restore the parts to moderately good condition by opening cysts and lessening the hardness and swelling, as may be done in all but the oldest cases.

2. Retroversion.—The treatment of this displacement, as a cause or as a complication, can go hand in hand with that of the catarrh, since it is easy to treat the cervix when a Smith pessary is in place by using a Sims speculum. The retroversion or retroflexion has first claim on our attention, except where the cervix is very sensitive or its condition is the evident cause of much suffering, or where the discharge

is excessive. Even then the displacement must be corrected at the earliest possible date.

3. Gonorrhœa.—This specific form of catarrhal inflammation demands special notice, because it is the most obstinate type we encounter, and because of the difficulty of making sure that gonorrhœa is the cause. Not that it is difficult to make a diagnosis when a sudden, profuse vaginal discharge develops, attended with frequent micturition and burning pain and red and swollen membranes, two or three days after doubtful intercourse, and followed by urethritis and swelling of the vulvo-vaginal glands. Nor is it difficult in older cases having this clear antecedent history, without going as far as Noeggerath. We admit a certain number of most intractable cases of chronic gonorrhœa of the uterine cavity, productive of sterility, and often accompanied by a persistent inflammation in the posterior vaginal vault, and by acute recurrent salpingitis or perimetritis or peritonitis. These are the troublesome catarrhs. Their treatment does not differ materially from that laid down farther on, but the prognosis is much worse.

4. Masturbation and Excessive Coitus.—We must be watchful for these two causes, and prepared to meet difficulty in coming to conclusions with regard to them. It is rare that women given to self-abuse will admit it. The subject is most unpleasant and embarrassing to approach or to retire from. Often our only wise course is a single forcibly worded warning against personal bad habits or self-indulgence as the cause of much local trouble; and that it is the cause of much local trouble I think one cannot doubt. Wherever, in an unmarried woman, the labia minora are large, darkened, pigmented, rugose, thickened, and insensitive, and the vulva readily admits of distension beyond the ordinary, we may suspect that handling has produced this result. Some cases show a very strong levator, and others complete relaxation of the pelvic floor. A few are much irritated about the vulva, while yet others bring us a varicose condition of the labia.

The same rules that apply to men guide us here. Cold baths, vigorous exercise, occupations that will take the attention from self and from idleness, hard bed, thin covering, cold room, and care about fulness of bladder and rectum and about sleeping on the back or face, are important. Any leucorrhœal discharge, the itching from which may have started the habit, must be checked. Displacements must be restored with as little manipulation as possible, and the least suspicion of sexual excitement during treatment may be promptly checked by sternness in an admitted case, and by hurting the patient in any case, or by strong pressure with the finger-tips on the pudic nerve as it passes along the inside of the horizontal ramus of the ischium opposite the anus (Brandt.) Often we find that masturbation has caused little organic trouble to account for much pain or distress, and we are glad

to be rid of the necessity for local interference. In excessive coitus we may reach our end indirectly by a talk with the husband.

In the married the conditions resulting from personal self-abuse are more difficult to make out. Married patients usually admit excessive coitus at once, but the kind of intercourse which may be classed with masturbation in its results, the dalliance or teasing of frequent, long-continued, but incomplete relations, is another almost impossible subject to handle, yet a frequent cause of undue pelvic congestion.

5. Adjacent Inflammations.—Among these, corporeal endometritis, subacute disease in the cellular or peritoneal surroundings (adhesions, thickenings), the chronic metritis and parametritis greatly insisted on by Schultze, or the cellulitis of Emmet, and ovarian hyperæmia, must be attacked.

6. General Condition.—In every case that comes to us we look for the various diatheses and blood disorders, and chiefly for anæmia and chlorosis, phthisis, nephritis, rheumatism, gout, syphilis, and scrofula. In many of these tendencies, as in rheumatic subjects, the mucous membranes show a special liability to obstinate catarrhs, so that we can secure only evanescent results without treating the general state. It is a matter of common observation that the obese, the lymphatic, and the blond are prone to leucorrhœa, and prolonged lactation gives us a troublesome type.

Bad hygiene, confinement within doors, indolent habits, faulty dress, fashionable dissipation, or unhealthful occupation is at the bottom of many cervical catarrhs that come on insidiously. No circumstances could be more exactly calculated to produce uterine catarrh than the ordinary regulations of school and society. During the years of their sexual growth young girls are locked up in school and dress, debarred from their brothers' muscle-training activity, and develop brain and "figure" at the expense of bodily vigor.

Cases requiring no Local Treatment.—By placing mild cases under favorable conditions many are temporarily relieved or permanently cured. Others require only such general care, plus the hot douche. But such cases are not frequently met with, for the reason—and for this reason alone—that few patients can be made to carry out a radical change in habits of living and dress or will persist in muscular work. Yet after examination every means must be tried before submitting a virgin to regular local treatment. Personally, I heartily believe that the time is bound to come when carefully regulated indoor and out-door exercise, bathing, and dress reform will be considered the chief and almost the only treatment required for all cases of cervical catarrh where gross pathological changes have not occurred.

Vaginal Injections.—Vaginal douches are indicated in most cases of leucorrhœa and in all chronic inflammations in the pelvis where heat

will favor resolution, and therefore in the catarrh and congestion of cervical endometritis. They are contraindicated in the presence of peritonitis, active cellulitis, salpingitis, or ovaritis. Where marked vulvar or vaginal sensitiveness exists injections may be prescribed for a fortnight before other treatment is begun, in order to toughen the parts.

Syringe.—Of the two forms of syringe, the fountain is to be preferred. The bulb syringe (Davidson or Higginson syringe) has the advantages of injecting a more forcible stream, and thereby cleaning off tenacious secretion more surely. It effects quicker absorption on account of the intermittent action, according to Emmet, who has systematized the use of hot water and rendered it scientific. But the bulb syringe is liable to cause distress by injecting air, and requires care to prevent the afferent end from slipping out of the basin. It is complicated and liable to get out of order, and has a rubber ball that soon splits. Moreover, the fatigue of operating the bulb is an almost insuperable objection to the prolonged daily use of it. A fountain syringe is best—one with a bag that will contain at least four quarts, and with hard-rubber nozzles. The large vaginal nozzle must not have a central opening at the end when it is to be used where the uterus is retroverted or where the cervix is torn and widely open, for fear of throwing the water into the uterine cavity. Where excessive tenderness of the vulva and vagina exists (particularly in young girls) I order a rectal soft-rubber tube to be used in the place of the hard-rubber nozzle.

Temperature.—Hot water is used, except in certain cases of relaxation, where the shock of cold water is recommended to tone up relaxed ligaments. It is ordered comfortably warm at first, the temperature to be gradually increased to the hottest the passages will bear, which is 120° F. or higher. Milne-Murray has shown that the contraction following such temperature is more persistent than that following the use of cold.

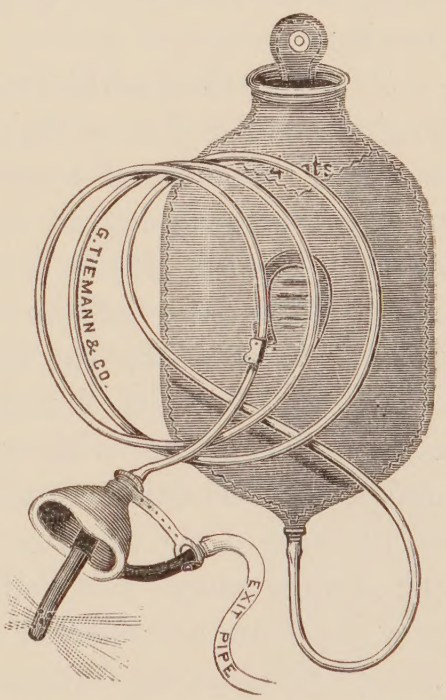
Quantity and Frequency.—For astringent purposes one or two quarts suffice, but to obtain the best results from hot water the quantity must be large, ranging from a gallon to several gallons at each sitting; that is, occupying ten to twenty minutes in passing. This should be repeated once or twice daily. Before retiring is a favorable time to soothe irritable or painful organs and secure lasting contraction of vessels.

Medication.—As a mild cleansing agent, and because a patient will use a syringe more faithfully if she thinks she is medicating diseased parts, borax in the proportion of a tea-spoonful to the quart is often recommended. As an astringent alum (½ drachm to the pint) acts efficiently. But the most satisfactory agent is sulphate of zinc, since it is astringent and disinfectant and does not stain. A tea-spoonful, which as ordina-

rily measured is two drachms, to each quart is sufficient. The patient should buy it in bulk for economy's sake (5-lb. tin, Squibb, $1.15). Hydrastis, permanganate, tannin, and iodine all stain the clothing by leaking out of the vagina after the douche.

Position in Taking the Injection.—The dorsal posture is the only efficient one, since it is the only posture whereby the entire surface is reached. The patient is directed to lie across the bed or at the foot of a couch, with the buttocks just over the edge and a chair to support each foot. The usual direction is to place a rubber sheet or piece of glazed American cloth under the hips, so that it trails into a bucket on the floor, that the fluid may follow its creases. For wealthier patients the Kelly pad is contrived to do the same thing conveniently. A much less sloppy plan than lying across the bed is to have a lid made for half the bath-tub; on this is laid a doubled blanket to go under the body and a pillow for the head; the patient then lies down with her buttocks projecting beyond the edge of the lid and feet resting on the lower corners of the bath-tub, with the knees elevated; the water drops directly into the tub. But the handiest device is a modication of Foster's apparatus adjusted to the fountain syringe. By its employment the rubber is not needed and the perineal skin surface is protected from the pain caused by the very hot water which the insensitive vaginal surface tolerates. The restraint on the outflow of the water, moreover, ensures distension of the vagina. The douche may be easily given in Sims's posture or in the knee-chest position with this instrument. Ordinarily patients sit or crouch during an injection, and hurry over the disagreeable treatment as rapidly as possible. Even on the comparatively comfortable seat of the water-closet, and with patients who can contract the levator and thus distend the vagina with water, the surface reached is small and the effect inadquate compared with that which is accomplished on the back.

Fig. 59.



Modified Foster Syringe for vaginal injections on the back or side.

Instructions to Patients.—We must describe the details of our method to a patient if we expect results worth the trouble this treatment is going to be to her. We must inform her of the kind and size of syringe, the temperature and medication of the water, the posture to assume, the nozzle to use, and finally the direction of the canal; most women believe that the vaginal axis corresponds with the long axis

of the body. They should be told that it runs toward the sacral region.

Applications to the Cervix.—Our first care, and our constant care in local treatment, is to see that all instruments are sterilized by a scrubbing with hot water and soap, then rinsing well, followed by a scrubbing with biniodide solution (1 : 2000):

℞. Hydrarg. biniodidi,
Potassii iodidi, āā. ʒij;
Aquæ, ℥ij.
Sig: One drachm to a quart of water. For external use.

Boiling is easily done, and flaming is efficient and yet harmless, except to the edges of knives. Simplicity in construction and freedom from rust are important. Any instrument that is to be passed into the uterus must be especially cleaned, and is dipped in a strong carbolic solution, 1 : 5, or into biniodide solution, 1 : 500, before introduction.

A raw surface within the os or extending over more or less of the vaginal face of the cervix is the more frequent form of cervical endometritis. The canal contains glairy, tenacious, and adherent "white of egg," very trying to our patience to remove, but which must be entirely cleaned off the sensitive surface with all gentleness until the mucous membrane of the entire cervical canal is dry, before that surface is prepared for the application. The swab is generally efficient. A slender, flattened, flexible rod of copper, square-edged, not roughened at the end nor with an olive tip, lest the cotton be hard to remove, makes the best carrier. On its end the swab of dry absorbent cotton of the size of the canal is firmly rolled, and then rotated therein until the stringy mucus is coiled and caught and withdrawn. This process may have to be repeated many times. Skene uses his dull spoon-curette to clear the mucus away.

Among local applications my preference runs strongly toward iodine and carbolic acid, 2 : 1. It is applied to the canal and to any erosion of the outer surface of the cervix, either on the swab (care being taken that it is not allowed to run out over the vagina) or by the long pipette curved upward at the end. The carbolic acid soon anæsthetizes the surface and relieves the pain of the treatment. Its permeating odor in the office is the main objection to this valuable preparation. Once in five to seven days is often enough to apply it, as time must be given for the mucous membrane to be thrown off and renew itself. Churchill's tincture of iodine, carbolic acid, nitrate of silver (20–60 grains to the ounce), chloride of zinc (20–60 grains to the ounce), may be used if the above loses its effect; but the last two cause

some pain. With very sensitive canals we may use a 4 per cent. cocaine solution before application or trust to the glycerin vaginal tampon for a while to prepare our way; or we may employ iodoform or aristol in vaseline, the powder being suspended and the mixture melted just before it is sucked up into a warmed pipette. Where granulations are present, clipping with the scissors, burning with the fused stick of silver nitrate or the fine galvano-cautery wire must be trusted to remove them. These applications are continued weekly from one to six months, or in chronic cases for a year, if distinct improvement is visible; the interval between treatments being gradually lengthened. If no progress is made with due attention to exercise, dress, bathing, and other hygienic and general measures at the end of two or three months, we must treat these mild chronic cases like the severe ones.

THE GLYCERIN TAMPON.—One of our most trustworthy measures, which is generally employed immediately after the application to the cervix, is the glycerin tampon. The material should be prepared antiseptic wool (Metcalf). Absorbent cotton soaks into heavy, hard wads that become painful, and ordinary cotton batting becomes nearly as uncomfortable. But a good specimen of wool is non-absorbent, thoroughly elastic, clean, and loose, but of long fibre, so that it hangs all together. It makes a perfect cushion for a tender cervix and lets fluid drain through it easily. It costs $2.50 a pound, but goes a long way. Tampons are made long and loose, with the bobbin tied near one end, so that when the patient pulls on the tape the wool does not double up. The bobbin of a second or third tampon, if several are used, is knotted at the outer end, so that the tampons can be removed in the order of their placing, and not pulled through a small vulva as a single large wad.

FIG. 60.

Wool Tampon.

Before introduction the wool is dipped into a wide-mouthed bottle containing a glycerin solution, in order to soak up 1 to 2 drachms of the fluid. The depleting effect of glycerin is remarkable. During the next few hours the tissues become wrinkled and fluid leaks freely out of the vagina, and of this flow the patient must be warned. The addition of boric acid to the glycerin, boro-glyceride (50 per cent. solution down to 1 ounce to the pint), is very valuable as an emollient and antiseptic, and is my constant substitute for plain glycerin. Alum in glycerin ($\frac{1}{2}$ ounce to the pint) makes a better astringent than tannic acid in cases of hypersecretion and great relaxation, because it does not stain the linen. Where absorption of the results of inflammatory action is desired, ichthyol (5 per cent. solution in glycerin) possesses wonderful power. Its action is so good as to overcome the objection to its odor and its staining properties. Only the best quality of glycerin (such as Bowers')

should be used with all these preparations. The tampon remains in place forty-eight hours unless there is very free or foul leucorrhœal secretion.

Treatment of Cysts.—In all cases of cervical endometritis cysts are carefully sought, and are usually readily found when present—sometimes seen as whitish or pearly or yellowish spots and elevations, sometimes only detected by the finger as shot or pea-like bodies imbedded in the softer cervical tissue. They are to be opened ten minutes after swabbing the surface with a 4 per cent. cocaine solution if necessary, with a spear (Buttle's), arrow-headed or sickle-ended, tearing the opening wide so that it will not close over. The fine incandescent wire of the cautery used in the nose may be employed or a small knitting needle heated over an alcohol lamp. These measures prevent closure of the opening.

In severe cases of long standing, where all these measures have shown themselves useless, several satisfactory means present themselves: dilatation, curetting, electrolysis, and removal of cervical tissue. In chronic cases we should not waste too much time on the slow measures when no progress is made.

Dilatation.—The canal is usually well dilated in catarrhal states, but in congenital deformity, where the narrowing is usually found at the external os in the conical cervix, in sterile women or virgins (pin-hole os), or in stenosis due to vicious use of caustics, Ellinger's dilator or bilateral incision is necessary. Schultze gives $\frac{3}{8}$ inch (4 mm.) as the normal size. In deciding whether or not to dilate we judge, however, rather by the amount of obstruction to free passage of the secretion and by the amount of rigidity than by inches. (See references under Corporeal Endometritis.)

Electrolysis.—Apostoli[1] advocates the destruction of the mucous membrane by the use of high currents. With the large clay electrode over the abdomen and an intra-uterine electrode in the canal the patient is gradually given as high as 200 milliampères for five to ten minutes every second to seventh day, if she can tolerate it—less if she cannot. The internal pole is positive in all hæmorrhagic diseases, negative in others. The patient goes to bed afterward. Three to thirty applications are required according to the chronicity of the case. Electricity cannot replace the spear for the destruction of cysts, and the curette where the canal is roughened with diseased and thickened membrane.

Removal of Cervical Tissue.—Where long-standing disease has engendered a gristly, irregular, intractable thickening in the canal, the cutting curette may be trusted to initiate a cure by paring away all

[1] *Sur un Nouveau traitement de la Métrite chronique*, Paris, 1884, abstract *in American Journal of Obstet.*, Jan., 1887, 111.

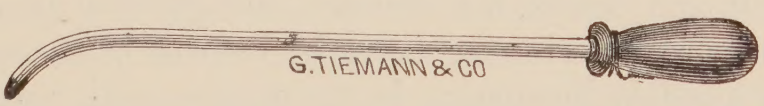
the diseased tissue except a narrow strip front and back, left to prevent union within the canal. In cases where much thickening and outrolling of the lips has occurred, often resembling laceration, if applications fail we succeed by resection of the cervix. Schroeder removes the inner face of the everted lips and rolls the mucous membrane of the vaginal portion inward and sutures it; and some remove a wedge out of each side.

Chronic Corporeal Endometritis (including General Endometritis and Uterine Fungosities).

General Treatment.—What has been said on this subject in the matter of cervical disease applies with still greater force to this less frequent and less tractable form. Constitutional diseases and diatheses must be hunted down and the most careful hygiene enforced. We refer the reader to the sections on dress, exercise, and cold bathing.

Medication of the Cavity of the Uterus.—Applications to the endometrium are contraindicated in the presence of tenderness of the uterine wall due to acute congestion or when lurking inflammation in the surrounding cellular or peritoneal tissues exists, as there is danger of exciting a new attack of inflammation. Medication of the corpus is not required in most cases of general endometritis in the parous woman, because the cure of the predominant trouble, the cervical disease, will be followed by relief of the disease higher up.[1] Leaving out, then, (1) the constitutional cases and (2) those in which the cervical region is chiefly involved, we have left (3) patients with very moderate cervical catarrh, but with patulous internal os and enlarged and very tender cavity, often with a tendency to bleed at a touch, with pronounced dysmenorrhœa and metrorrhagia or menorrhagia, as the commonest signs. These may be treated with great caution in the same way that we treat the cervix, beginning with the mildest applications to test the toleration of the cavity. Plain boiled water, iodoform 3 to 5

Fig. 61.



Skene Instillation-tube for making Applications to the Uterine Canal.

grains in 15 minims of melted vaseline, fluid extract of hydrastis, pure carbolic acid, and iodine with carbolic acid, form stepping-stones to be used one after another. They are best applied through a Skene instillation tube or pipette, after carefully cleaning the surface with the swab.

The Curette.—Our most rational and valuable resource is the

[1] Palmer, *Amer. Syst. Gynæcology*, i. 576.

curette. It cuts away the thickened, softened, granulating, and diseased membrane, leaving the glands that dip into the muscular layer,[1] and permits a healthy growth to follow. In the absence of latent acute inflammation in the vicinity, by the use of an instrument like Skene's, that cannot gouge out the muscular wall, under antiseptic precautions and in moderately skilful hands it is safe. Sterility as a sequel need not be feared.

In the hæmorrhage due to *uterine fungosities*, a variety of the disease we are considering which is at the bottom of most continuous or rebellious uterine blood-loss, there is no treatment to compare with it in rapidity and efficiency.[2]

Apostoli reports excellent results from destruction of the mucous membrane by galvanism, running up to 200 milliampères, in chronic corporeal endometritis. I object to these fierce currents. We do not want "to carpet the cavity with scar-tissue,"[3] and in the curette we have a means of knowing how much our agent is doing when at work on the surface. I have had good results with galvanism, but restrict it to cases in which the sound shows no extensive disease, such as roughnesses, thickening, continued bleeding at a touch, which the curette is suited for. From 50 to 100 milliampères continued from five to ten minutes ought to suffice, and in many milder cases 20 to 30 will relieve, but the treatment must be long continued.

Acute Metritis.

Acute puerperal metritis is treated of elsewhere.

At the commencement of an attack of acute metritis the bowels are thoroughly emptied by a saline—but not by purgation—or by an enema containing, for instance, sulphate of magnesium, to be followed by a suppository of extract of belladonna, $\frac{1}{4}$ grain, or of morphine, $\frac{1}{8}$ to $\frac{1}{2}$ grain, or of the two together. Hot applications over the lower part of the abdomen give comfort, and in active cases the ice-bag or ice-coil may be used. Absolute quiet in the recumbent position is directed. During convalescence warm baths, iodine to the hypogastrium or even to the vaginal vault and cervix, hot douches, and glycerin tampons are useful. The rare sequel, abscess, shown by increase of the symptoms and swelling or possibly fluctuation in the uterine wall, requires incision, while rupture into the peritoneum necessitates laparotomy.

Chronic Metritis.

Under this heading is included subinvolution, areolar hyperplasia, cirrhosis, and sclerosis.

[1] Palmer, *Am. Syst. Gyn.*, i. 569 and 594.

[2] For the method see *Amer. Syst. Gyn.*, i. 598; Thomas, *Diseases of Women;* Skene; or Mundé, *Minor Surgical Gynæcology.*

[3] Pozzi, *Gynécologie.*

Prevention.—Since a large proportion of these cases date their trouble from a labor or abortion, we must again insist on bimanual examinations during the puerperium. Retention of portions of placenta, laceration of the cervix, retroversion, pelvic inflammation, rising too soon, non-lactation, and repeated miscarriages are the cause of most subinvolutions (Hart). Ergot and quinine, hot douches, iodine, and electricity may be recommended here, but the subject is fully considered elsewhere.

General Treatment.—These cases are essentially chronic, and control of the patient is essential to success. As this is an "increased connective-tissue formation dependent on long-continued hyperæmia, our first object is to diminish the passive congestion of the pelvic organs." Rest and exercise must be proportioned to the special need of the case. The patient is directed to lie down at certain specified intervals—just before the midday meal and the evening meal, for instance. Out-door exercise must be planned. Special gymnastic work is laid out, particularly with reference to menorrhagia or amenorrhœa. (See Mennorrhagia, Amenorrhœa.) The cold spray is recommended if the patient has sufficient tone. The bowels are regulated by mineral waters or such a pill as Dr. Skene's combination of quinine 1 grain, extract of belladonna $\frac{1}{10}$ grain, compound extract of colocynth $\frac{1}{2}$ grain. Rest in the horizontal position is enforced during menstruation to prevent exacerbations, and coitus must be limited. Sedentary occupations and those requiring long standing in one position are hurtful, and dress that dams blood back into the pelvis aggravates the disease.

To the worst cases Winckel's forcible words apply, as they do to all chronic uterine disease: "It is understood, of course, that with such a patient the diet, the various functions, physical and mental occupations, her movements, and her times of rest are carefully regulated. She is given to understand that she is being treated by a man who clearly appreciates her exact condition, and whom she must obey. Many of these sick women, after long years of illness and contact with numerous physicians, have become acquainted with a series of remedies which they have no hesitation in quietly substituting at will. Anodynes are more particularly their resource, and these are particularly harmful for them: they increase apathy, they render peristalsis sluggish, they favor stasis in the pelvic organs, and make the sufferer chafe more than ever at her conditions of life."

Where the patient is able to undergo expensive treatment and the disease is rebellious toward simpler means, the Weir-Mitchell rest-cure, described in Volume I., is of great value. The relaxation, the graduated massage, electricity, and exercises, the forced nutrition, and the favorable surroundings cause such marked improvement in the circulatory, muscular, and digestive systems that comparatively little local

treatment is required and its efficiency is greatly enhanced. With this method, as with all others, however, judicious selection of cases is required.

Measures directed to the Uterus itself.—In the larger number of cases of chronic inflammation of the uterus the cause arrests our attention at once, and the remedy directed to the cause cures the metritis. (1) Laceration of the cervix demands repair; (2) retroversion calls for replacement; (3) anteflexion requires straightening or dilatation; (4) prolapsus needs support; or (5) chronic endometritis exhausts our patience. Occasionally (6) a tumor in or near the uterus is the source of the disease. In each of these cases the return to the normal size and consistency occurs with remarkable promptness after relief of the condition causing the hyperæmia and hyperplasia in the uterine wall, provided the difficulty has not been of such long duration that cirrhotic changes have taken place.

If the cervix has become much thickened speedy diminution in size may be promised after the simple and rapid operation of removing two V-shaped wedges from the cervix by a bite of Skene's hawk-bill scissors on each side; after which the openings are sutured. Should the cervix be elongated, amputation will effect the same end, and is required.

Local Treatment.—Hot vaginal douches will stimulate the pelvic circulation, and should be ordered at bed-time, to be taken in the horizontal position with a large quantity of water. Iodine applications to the canal and cervix every fifth or seventh day, and glycerin tampons, carrying boro-glyceride, alum, or ichthyol, after each use of the iodine, and halfway between the iodine applications, are trustworthy measures. Apostoli gets good results from galvanism,[1] and his method seems to be gaining its way. It is described under Fibroids. But currents of 50 to 100 milliampères are sufficient in the experience of many men, and should be first tried. The Germans favor local bloodletting before the period when the menstrual flow is scanty.

Retroversion of the Uterus.

The two indications in the treatment of retroversion are—

1. Replacement of the uterus;
2. Retention in normal position.

Replacement may be effected in these ways:

I. By bimanual manipulation;
II. By position and instrument;
III. Partially, aided by pessary;
IV. By massage:
V. By operation.

[1] *Sur un Nouveau traitement de la Métrite chronique*, Paris, 1886, Doin.

I. Replacement by Bimanual Manipulation.—This method, the best of all methods, can be practised when the abdominal walls and pelvic floor are moderately relaxed and not unduly sensitive—best in a woman who has borne children—and when the abdomen is not thickly cushioned with fat.

The bladder and rectum must be emptied and the dress entirely loosened about the waist. The patient is placed on her back on the examining table. Her shoulders are well elevated and her head thrown forward to relax the abdominal muscles; her buttocks are brought down to the edge of the table, when her vagina opens far back. The bimanual examination is repeated, in order to make sure there are no adhesions or inflammatory trouble in or about the uterus, broad ligaments, or utero-sacral ligaments. (1) One finger is introduced into the vagina and carried along the back of the uterus as far toward the fundus as possible, and the fundus is slowly pushed forward. If a good vaginal reach is impracticable, the finger is passed into the rectum and above the troublesome fold or valve found a short distance beyond the internal sphincter. The upward pressure is directed to one side of the median line in order to keep clear of the promontory, and best to that side of the promontory on which the fundus is found. (2) Meanwhile the fingers of the other hand are making gradually increasing pressure on the abdominal wall, and as it slowly gives way the finger-tips approach the promontory. Circling massage movements enable us to reach deeply with the least distress, or the patient may be directed to cough or to catch quick breaths to lessen the tension of the abdominal wall. (3) When the fundus has been pushed forward by

FIG. 64.

FIG. 62.

FIG. 63.

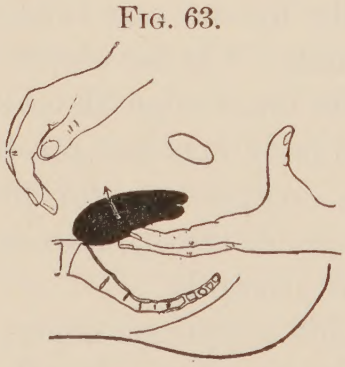


FIG. 62.—Replacement of the Retroverted Uterus: the fundus lifted by the inner hand.
FIG. 63.—The Outer Hand reaches for the Fundus.
FIG. 64.—The Fundus carried Forward and the Cervix Upward and Backward.

the inner fingers within reach of the outer, the latter take the fundus in charge and carry it toward the symphysis, while (4) the fingers in the vagina push the cervix backward and upward toward the sacrum. Beginners make the mistake of lifting the whole organ toward the

promontory; thereby the fundus goes out of reach of the outer hand. The uterus must be lifted forward.

II. **Replacement by Instruments and Position.**—When the abdominal wall is very muscular or tense or tender or thick with fat, or when the vulvar and anal openings are too sensitive for such manipulations, we may resort to two other manœuvres:

1. With the patient in the knee-chest position a Sims speculum is passed and the vulva well opened. The anterior lip of the cervix is caught with a double tenaculum. Then a firm ball of cotton, in the grasp of a sponge-holder or lock-forceps, is pressed against the fundus, while the cervix is swept toward the coccyx and sacrum. Steady pressure is made.

2. If it fails, the forceps and speculum are withdrawn, leaving the tenaculum to grasp the cervix for our next attempt. The patient remains in the same position; the forefinger is passed into the rectum; its tip presses the fundus toward the promontory, and the cervix is drawn toward the vulva, and then backward toward the sacrum. The tenaculum serves to steady the uterus and to bring it within reach of the finger, for in the knee-chest position all the pelvic organs fall toward the diaphragm.

III. **Partial Replacement.**—Replacing as far as possible when complete success is unattainable, the gain is held by a tampon or pessary.

Action of Pessary.—The pessary is held upward by the elasticity of the vaginal walls—which are narrowest below—by the bulbo-cavernosus or constrictor cunni muscle, and by all the elastic strength of the sloping sacral segment. But its most important support is furnished by the edges of the levator ani. These edges may be felt as two thick bands passing the lateral vaginal walls nearly at right angles to the vaginal axis half an inch within the hymen, and running in a nearly horizontal position as the woman stands. On the slopes of this V-shaped gutter[1] the pessary rests, and at its lower edge should lie the lower end of the pessary. A torn perineal body may not preclude the use of a pessary, because the levator often compensates for the injury by drawing the vaginal opening forward under the symphysis, but a torn levator permits a pessary to drop out promptly.

The Smith pessary holds a replaced uterus in position by backward and upward traction on the post-vaginal wall, so keeping the cervix in the back of the pelvis. Upon a partially replaced uterus it pulls steadily in the same way, and it is often of use where replacement is found impossible at the earliest sitting by slipping under the fundus and holding it upward, just as the examining finger does. Every time the patient is in the genu-pectoral position it has a chance. As she sleeps partly on

[1] *Amer. Journ. Obstet.*, Sept., 1889, "The Levator Ani," Dickinson.

her face, it can act, and one finds that it often does more than merely to keep what it is given in the way of improvement in position. It also acts by supporting the uterus as a whole and diminishing tension on the utero-sacral ligaments, thus giving them opportunity to recover lost tone.

INDICATIONS FOR PESSARIES.—After successful reposition by one of the methods given; after partial replacement; in cases where attempts at reposition fail, but no contraindications exist, such as inflammation, tender displaced ovaries, adhesions, or marked retroflexion. The third indication is debatable truly, but practically the method succeeds, though it is unwise to teach to the unskilful, as it countenances lax practice.

CONTRAINDICATIONS TO THE USE OF PESSARIES.—Inflammation, tender prolapsed ovaries, laceration of cervix or perineum, adhesions, acute-angled retroflexion, marked shortening of the posterior vaginal wall. Any degree of acute inflammation within the pelvis banishes the idea of a pessary; remains of cellular or peritoneal inflammation must be overcome by ichthyol or boro-glyceride tamponing, the hot douche, or massage before a pessary can be considered, and vaginitis or vulvitis must subside. The worst grades of endometritis, involving tenderness, must be treated. Tenderness in ovaries lying in the pouch of Douglas requires their elevation if possible, and retention by tampons, or else iodine as a counter-irritant to the vaginal vault in their vicinity. Laceration of the cervix calls for repair, because the upper curve of a pessary cannot pull the cervix backward when the cervix is split, but merely makes it gape. When the levator ani is badly injured no pessary can be retained or hold up the uterus, even where the perineal body is intact; and when the laceration has involved the muscles of the pelvic floor between the vagina and anus, the pessary is forced out at stool or by other effort. A good perineal body must be built. Adhesions and retroflexion are dealt with later. The shortened posterior vaginal wall of long-standing displacement may sometimes yield to tamponing and an elastic ring.

TREATMENT PRELIMINARY TO THE USE OF PESSARIES.—In young girls or in any patient with small or sensitive passages preparation is often requisite to render the parts tolerant of the instrument. The hot douche will be useful. When the uterus can be partly or wholly replaced a small boro-glyceride tampon is packed behind the cervix through a Sims speculum, and a larger tampon is placed in front of the cervix, pressing it backward, with a knot on the tape of this lower one to show that it is to be first withdrawn. They may remain forty-eight hours, and be repeated once to four times at a few days' interval. Then an elastic ring pessary of the same diameter as the transverse measurement of the vagina is introduced. A week later

a soft-rubber pessary is fitted as described farther on; and finally the hard-rubber instrument that is to be permanent is fashioned.

Measurement.—In most cases, however, we may proceed at once to fit the pessary, and we will take the Albert Smith or Emmet as a type. The patient is placed in Sims's position and a Sims speculum is introduced. The end of an applicator or forceps, carrying a wad of cotton, is pressed snugly up into the vaginal vault, and a finger-tip is placed on the shank at a point corresponding to the middle of the urethra; that is to say, about half an inch inside the hymen on the anterior vaginal wall. This is about the lower edge of the symphysis. The mistake of beginners is making a pessary too long. If it is visible when the vulva is gently drawn open it is too long, and will cause discomfort to the wearer when sitting down. It should be well within the hymeneal orifice. Width is a less important matter and may be estimated with the finger. When in place the anterior vaginal wall must not be rendered tense.

The curve of a pessary is gauged by ascertaining the length of the posterior lip of the cervix or the depth of the posterior fornix. The upward curve of the pessary is made a little less than this. The downward curve is made about equal to the posterior. When the S curve of the vagina is pronounced the pessary must be strongly curved to correspond. An exaggerated lower curve may interfere with coitus.

After introduction the posterior fornix may be found so distensible that a longer instrument must be used. It is better to employ at first, however, a pessary presumed to be too small than one which might overdistend the vagina. During the following weeks several modifications in shape are likely to be called for. With the soft-rubber ring the changes are readily made. But skill is required, and each case must be studied and specially fitted. An instrument that fits well gives no intimation of its presence. Finally, an examination in the upright position gives valuable information where difficulty or doubt about fitting occurs.

The material of the pessary first used is fine coiled copper wire covered with soft rubber. The ring should take any shape desired, and yet have sufficient spring or elasticity to admit of compressing the sides during introduction and withdrawal and to give a slightly elastic action. The soft-rubber pessary cannot be retained longer than a few weeks without absorbing discharges and becoming offensive. Therefore, when the instrument has been satisfactorily adapted to the needs of the case, a copy in hard rubber is made, either by an instrument-maker, to whom the soft one is mailed, or by the practitioner. Water near the boiling point softens the hard-rubber ring, or after being greased it may be held over an alcohol lamp and very slowly heated. Then it is shaped and plunged into cold water to harden.

INTRODUCTION OF PESSARIES.—The patient lies on her back; the index finger of the left hand is hooked into the vulva, and draws steadily backward for a minute or more to tire the resistance. Then the pessary is slipped in, as shown on the diagram, to press back the

FIG. 65.

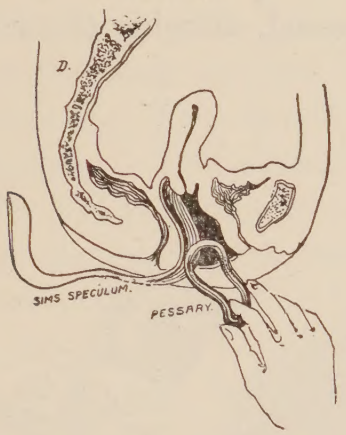


FIG. 66.

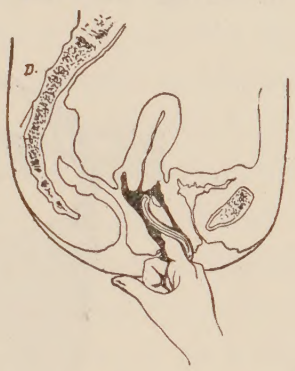


FIG. 65.—The perineum is drawn back and the pessary turned antero-posteriorly.
FIG. 66.—The pessary is twisted and the upper bar depressed to pass the cervix.

perineum, turned on its side, and rotated after it has nearly passed the hymen. Care must be taken not to press on and hurt the vestibule. The upper curve tends to run against and up the front of the cervix. It must be piloted backward by the tip of the index finger, passed behind the instrument to its upper curve, which is then pressed onward to its position behind the cervix.

Or the patient may lie on her side while a narrow-bladed Sims speculum draws the perineum backward and allows the pessary to be easily introduced or withdrawn—with this advantage, that we see what we do.

Once a week for two or three weeks the patient is seen and any required changes made. Then a hard-rubber pessary is substituted, and she reports monthly for bimanual examination, as well as examination with a Sims speculum to look for cutting. Before long a smaller instrument will do the work, and after some months it should be withdrawn to see whether it is still required. A few patients need to wear an instrument for years. It is usually good practice to let a pessary remain out one week out of six or eight, to permit the vagina to regain its tone.

If pregnancy occurs, the pessary may be left in place until the fundus is well out of the brim.

INSTRUCTIONS TO PATIENT.—1. She is warned to return if the pessary causes any pain whatever or if the discharge is increased, and to remove it herself under these conditions if it is of the soft variety and she lives at a distance.

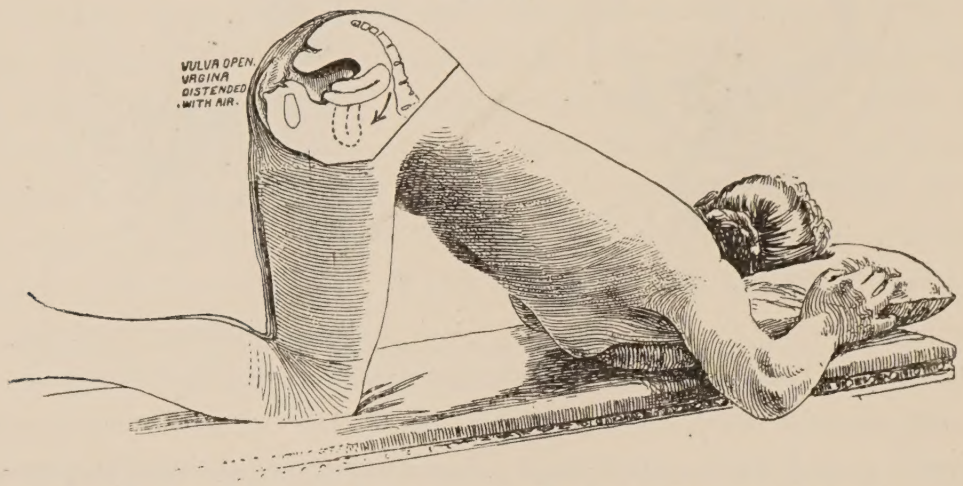
2. She is directed to use a hot or cold vaginal injection daily for

the sake of cleanliness, or to give tone to the relaxed utero-sacral ligaments and blood-vessels, or to hasten absorption.

3. She is cautioned that an over-full bladder or rectum will be likely to displace her uterus again; also, that at first straining at stool or vigorous effort of any kind may cause a relapse.

4. She is told to assume the knee-chest position from five to ten minutes morning and night when undressed, drawing the vulva open

FIG. 67.



The Knee-chest Posture. The thighs are perpendicular. Air enters the vagina; the uterus rises in the abdomen and may fall into position.

to admit air, and, when tired, sinking on the side, to lie there some time.

5. She is strenuously charged to hang all her clothing from the shoulders and to avoid waist-constriction, and is instructed in the details of healthy dressing.

6. Her exercise and out-door work and bathing are regulated if possible.

If she has difficulty in introducing the syringe or in intercourse, the passage is shown to be clear on the rectal side of the obstruction.

Adhesions.—As the result of one or more attacks of localized peritonitis this complication is frequent, and is always to be sought for. In many cases adhesions are difficult to detect, and to the inexperienced difficult to differentiate from catching of the fundus under the promontory. When, therefore, thorough attempts to replace the uterus fail, they must be again diligently searched for (1) by fixing a tenaculum in the cervix and drawing the uterus down in order to render them tense to the examining finger in the rectum; (2) by bimanual palpation under nitrous oxide or ether.

When adhesions are *recent*, following an inflammatory attack, they should be stretched by repeated packing of the posterior vaginal vault with wool tampons. The upper pledgets should be soaked in ichthyol-glycerin, 5 per cent. The packing is done with a Sims speculum in the knee-chest position, is replaced every second or third day, gradually

increasing the tightness of it, and may be begun as soon as tenderness has subsided. It is less scientific than massage, but better suited to unmarried or excitable women.

The ichthyol is of much importance in this treatment. Its action in promoting absorption of scars and bands is sometimes rapid and well marked.

IV. **Massage.**—To give the treatment according to Brandt, a couch four feet long and two feet four inches wide, solidly stuffed and flat, is required. This should be of the same height as the seat of the operator's chair. The patient's clothing must be entirely loosened and the bladder and rectum empty. She assumes a half-lying, half-sitting position on the couch; her head and shoulders are raised and bent forward by an inclined plane or by cushions, her knees and thighs strongly flexed on the trunk. In this position the pelvis rotates upon the heads of the femora. The lower part of the sacrum serves as a support for the pelvis, whose angle of inclination is diminished. The symphysis pubis is perpendicular to the plane of the couch; the vagina takes a horizontal direction. The cushion for the head is so placed that the chin almost rests on the chest. This relaxes the abdominal integument and prevents the contraction of the lumbar muscles.

The operator's position is at the left of the patient, his face turned toward her. He introduces his left index finger under her thigh into the vagina without uncovering her, and rests his left elbow on his left knee, thus making the treatment less fatiguing to himself and at the same time gaining in surety and exactness of touch. His right hand is placed upon the patient's abdomen just above the symphysis pubis.

In conditions where there are exudates to be softened or cicatricial bands to be stretched the finger in the vagina merely presses the organs toward the right hand, and is held as motionless as possible while the right hand executes the movements. The middle, ring, and little fingers of the left hand should not be bent, for either cramps and fatigue to the operator, or discomfort to the patient from the pressure of the knuckles on the perineum, would be the result.

Beginning with very gentle pressure, the hand on the abdomen makes small circular movements, and during these movements bears on the belly-walls with steadily increasing pressure, and deeper and deeper until the infiltration to be kneaded lies directly between the fingers of this hand and the finger in the vagina. The finger-joints and wrist are kept rigid, and the motion is made at the elbow and shoulder. Whenever feasible, massage is done, not with the finger-tips, but with the palmar surface of the third joint of the index and middle fingers or middle and ring fingers, eventually with all three together. With large exudates Brandt lays stress on beginning at the periphery; that is, on emptying the adjacent lymph-glands, that they may be

ready to receive and pass on the material forced toward them later—an important principle in massage. In these cases he commences with circling and stroking motions over the promontory and anterior sacral surface, with the palm directed toward them.

In stretching ligaments or seeking to render the ovaries or uterus movable the outer hand is to be moved, during the circular stroking, in the directions in which the adhesions are to be stretched. If, for example, the uterus is adherent near the brim of the pelvis, the hand works in circles along the adhesion or shortened ligament from the bone toward the uterus, and gradually presses the uterus toward the median line and beyond it, while the finger in the vagina shifts its place very slowly and quietly in order to keep opposite the manipulating fingers. Finally, tremulous (*zitternde*) motions are made use of to stretch or pull out the ligament (*zur Auszerrung*). In shortening or thickening of the utero-sacral ligaments, however, the hand works toward the promontory (Jentzer).

The invariable rule is that the movements must never be of such vigor as to give pain. They are always preceded or followed by certain of the gymnastic movements described under Anteflexion.

The length of a sitting is between two and fifteen minutes, according to the sensitiveness of the patient, and they are to be given once or twice a day. During the earlier treatment brief and gentle massage is requisite, but, since the sensitiveness usually subsides rapidly, longer and more vigorous pressure is soon permissible. Too much must not be attempted at first; excess is harmful or painful. The sittings must not cease during menstruation, as much more can be gained during the succulence and relaxation of this period than at any other time.

V. Operations.—1. *The Alexander-Adams Operation.*—Where the uterus is replaceable, but pessaries cannot be worn or the patient is too poor or impatient for the long pessary-treatment, or where tender prolapsed ovaries prevent this treatment, or where it fails, an operation which has gained considerable foothold is the following: "The Alexander-Adams operation consists in dissecting down upon the external abdominal rings, catching up the fibres of the round ligament as they pass through the rings, pulling out as much of them as will restore the uterus to its normal position (three or four inches), and stitching the shortened ligaments to the pillars of the external ring."[1]

2. *Schultze's Operation.*—In cases of fixation of the uterus by old adhesions massage sometimes succeeds. Where it fails or is deemed inadvisable, the operation may be undertaken whenever the suffering is of a sufficient degree to warrant a certain amount of danger.[2] It

[1] Full literature in Wood's *Reference Handbook*, vii. 462.

[2] *Zeitsch. f. Geb. u. Gyn.*, 1887, 1, and book on *Displacements*, Appleton, 1888.

consists in carefully tearing the adhesions from the uterine surface while replacing the uterus.

3. *Ventral Fixation*, or *Hysterorrhaphy.*—H. A. Kelly's operation consists in opening the abdomen by median laparotomy and stitching the uterus to the anterior abdominal wall. The gravity of a laparotomy, the abnormal position which is the result, and occasional loosening and relapse, are serious objections.

4. *Dudley's Operation.*—In patients with fairly healthy tubes and ovaries and with adhesions or periuterine disease otherwise intractable, Dr. A. P. Dudley[1] operates by opening the abdomen, denuding a strip on the anterior face of the uterus, and likewise a strip along the inner side of each round ligament, and suturing the three together. This operation is also *sub judice.*

Retroversion in Pregnancy.—The enlarging uterus is more easy to replace than the non-gravid : where there are adhesions nothing can soften them and make gradual traction upon them as effectually as utero-gestation. It goes without saying that the case must be carefully watched, and that the knee-chest position, frequent attempts at replacement, and a pessary must assist the process. After delivery frequent emptying of the bladder, rest on the side, regular examination, and reposition whenever displacement is found, holding the gain by a pessary, will result in a permanent cure. Solid and strong adhesion of the uterus is not included under this favorable prognosis; in these cases abortion results when the fundus strikes the sacral wall.

Retroversion, Congenital or Due to Puerile Arrest of Development.—In these cases, with short anterior vaginal wall, conical cervix, and small uterus, reposition may not be difficult, but retention is. If the vagina cannot be gradually distended by pessaries (ring and Smith), it is better to confine the treatment to the cure of complications. Conception is not hindered and pregnancy cures the difficulty.

Retroversion from Anterior Fixation of the Cervix.—The indications here are to promote the reabsorption of the residue of the inflammatory action which drags the cervix forward by ichthyol, by the hot douche, and possibly by massage.

Retroflexion.

This deformity is usually a complication of retroversion, and what has been said on that topic applies to this. Great care must be taken, however, with very acute flexions or those which readily return after reposition, because if a pessary is used to retain the uterus in place our next examination may discover the return of the trouble, with the upper curve of the pessary pressing into the angle of flexion, increasing the difficulty. The Elliot adjuster may be gently

[1] *Trans. N. Y. Med. Ass.*, 1890.

and repeatedly used to straighten the flexion if it readily yields; and when the tendency of the canal to a sharp bend is less marked a pessary with very moderate upper curve may be tried. In obstinate cases the intra-uterine stem pessary acts well, but this is an instrument that often does harm and is rarely needed. Massage, the Alexander-Adams operation, and Schultze's operation relieve rebellious cases.

Anteflexion of the Uterus.

In anteflexion we are called on chiefly to relieve two symptoms, dysmenorrhœa and sterility, although irritability of the bladder, leucorrhæa, menorrhagia, and various pains are often complained of.

We encounter, broadly, two classes of cases:

1. **Congenital Anteflexion,** or that due to arrested development. In a typical case the uterus is undersized and imperfectly developed, the cervix is small and conical, with a pinhole os pointing toward the vulva; the invagination is scant and the anterior vaginal wall short. The individual is often poorly developed, chlorotic, debilitated, or lacking muscular tone.

2. **Acquired Anteflexion, due to Inflammation and Shortening of the Utero-sacral Ligaments (Parametritis Posterior, Schultze).**—In a typical case pain is caused by the passage of hard fæces, or tenesmus is present when the movements are loose; intercourse is painful; the uterus is drawn upward and backward toward the sacral hollow, and the patient suffers when it is drawn forward; while distinct tenderness is found in the utero-sacral ligaments by rectal examination. In cases of long standing the ligaments atrophy and let the uterus descend.

Posterior Parametritis.—Where the tenderness behind the uterus is well marked our attention must be entirely directed to the inflammation there. No large masses of fæces must form and pass, and no diarrhœa with tenesmus be tolerated. Hunyadi or Rubinat water on rising does well. If enemata are required, milk or oil may be injected some hours previously. The patient must avoid strain and the increase of abdominal pressure caused by faulty dress. Sexual intercourse is forbidden, and when allowed later the husband is directed to keep his thighs outside of his wife's. Ichthyol-glycerin tampons (see Endometritis) often accomplish striking results, used every third or fourth day, especially before the menstrual periods. Scarification of the cervix (bloodletting) just before the period is recommended. The patient remains in bed while menstruating. An Emmet or Graily-Hewitt pessary, to lift the uterus during the month, is a comfort in some cases; as the inflammation subsides hot douches are added to the treatment.

General Treatment.—It is generally admitted that in a large proportion of cases local measures for the treatment of anteflexion are

unsatisfactory and palliative merely, and the severe cases are known to be exceedingly difficult to relieve. We must therefore insist most strenuously on the general treatment, and the more so because a goodly portion of anteflexions occur in the unmarried, whom we are loath to treat on the table; because many anteflexions are directly due to lack of general development; and because, as a rule, in no uterine disease save in simple catarrh of the cervix shall we be so well repaid for attention to the constitutional condition, digestion, exercise, dress, bathing, and other habits.

Iron, arsenic, mercury, strychnine, cod-liver oil, and forced alimentation in the anæmic and debilitated, rest for the overworked shop-girl, and proper exercise for the society-girl, with care during the menstrual periods, and regulation of the bowels for all, must receive close attention.

Dress here also is of great importance, for the reason that increase of downward abdominal pressure, acting on the back of the bowed fundus, bends it farther still, and at the same time increases the strain on the utero-sacral ligaments; and for the further reason that the disturbance of circulation being one of the chief causes, if not the chief cause, of the dysmenorrhœa, we must have a care not to increase that difficulty. Upon general exercises and out-of-door sports and baths we lay great stress.

Special Exercises.—In cases of anteflexion where the pain occurs before the flow or during the scanty flow of the first day we can start the discharge more freely from the beginning, and save the patient from the usual suffering in a very large number of cases, by the movements Brandt recommends for amenorrhœa. These draw the blood to the pelvis and lower extremities, inducing a rapid flow in the common iliac artery. I have had some remarkable results from this course, and am in the habit of teaching it—particularly to young girls—before beginning any other treatment. In the few cases where menorrhagia is the abnormality a different set of movements is indicated to draw the blood away from the pelvis.

Treatment of Endometritis.—Frequently a marked catarrh aggravates the circulatory disturbance and blockades the canal. The treatment demanded is detailed under Endometritis.

Dilatation.—Stretching the canal is a measure of great value, and does much to cure dysmenorrhœa and sterility. But the relief is not often permanent when the measure is depended on alone, since recontraction soon takes place. The pregnancy that may follow the dilatation usually constitutes a cure. The use of the branched dilator (Goodell-Ellinger) is the best means for the method.[1]

Repositors.—To straighten the bent organ Elliott's elevator or

[1] See Mundé, *Minor Surgical Gynecology.*

adjuster acts well. Its point can be curved backward or forward by turning the disk at the outer end. With the patient in Sims's posture and the speculum in place, the curve of the canal is determined by the sound: instrument and canal being carefully sterilized, a tenaculum is hooked into the cervix to draw it down and steady it, and the elevator, bent to the curve of the sound, is gently slipped in, with care not to press on the fundus. The screw is very slowly turned until the fundus is carried back of a straight line if little pain is caused thereby. This straightening is repeated weekly, increasing the number of straightenings later to two or three, for months perhaps. If the passage into the uterus is painful, the canal must be first rendered tolerant by cocaine in mild cases, and by preliminary improvement of the cervical catarrh in canals much diseased. This straightening is unallowable where the ligaments are actively inflamed. It opens the channel for freer escape of the adhesive secretion, but acts mainly by stretching the bent wall and improving its nutrition. Its use may be immediately followed by an application to the diseased mucous membrane.

Electricity.—The gentle passage of graduated bulb electrodes past the flexion a few times just before a period, and with a current of about 10 milliampères, will relieve the dysmenorrhœa of some cases.

Medicines.—In the amenorrhæa of anteflexion, as a temporary means of relief until the other more radical measures have taken effect, manganese binoxide, in 1- or 2-grain pills, three times daily during the five days preceding the flow, is of occasional value, and in the rarer menorrhagia fluid extract of hydrastis, 10–20 minims after meals, may be tried for the time. For the pain, recumbency, the hot-water bag, or a phenacetin powder of 10 grains, repeated in an hour if required, give relief.

Massage of the Shortened Ligaments.—When the flexed uterus has been drawn well toward the upper sacrum by contraction of the ligaments, and also when the displacement from this cause is less marked, yet the previous treatment has not given relief, Brandt's method is a rational resource. The main objection, the danger of exciting the sexual feelings, has been stated, and must be weighed in the individual case. The method is given on page 774. I have had two cases in which massage has produced lengthening and relief of long standing where dilatation and Sims's operation failed to give comfort.

Pessaries.—The utility of any pessary but the intra-uterine stem is doubtful. Curative they cannot be, but an anteversion pessary, such as the Hewitt or a plain Smith with a bar across, may give some relief by lifting a heavy, congested uterus and lessening the drag on the tender posterior ligaments and the pressure on the irritable bladder. A remedy capable of much good in the hands of the skilful and of much harm in the hands of the unskilful, but which is not frequently needed, is the stem. In the absence of distinctive tenderness and intolerance

in the canal, of sensitiveness in the utero-sacral ligaments, and of thickening of the uterine wall, dysmenorrhœa of varying intensity, with, possibly, mechanical and spasmodic contraction at the internal os, may find in this method complete relief, perhaps because of freer secretion and better drainage.[1] The use of the Elliott adjuster as a preparatory measure, develops tolerance for the stem, and gauges such tolerance (Skene). Forcible dilatation is usually necessary before the stem can be passed. The stem is to be one-third of an inch shorter than the whole canal, to prevent irritation of the fundus by its point. The Thomas hard-rubber instrument, with cup fitted to a retroversion pessary, is recommended. The patient keeps quiet, after its introduction, for some days, and is most carefully watched for uterine colic, bleeding, or inflammatory warnings, such as tenderness of the uterine wall or swelling in the surrounding tissue, at the first sign of which the instrument is withdrawn. It may be worn for months, but must be removed periodically to search for irritation or injury.[2]

Cutting Operations.—In a few cases of very narrow and deformed canals, or where scar-tissue causes the contraction, the channel may be incised. But these operations are now rarely resorted to. They replace one deformity by another, and are not without danger. Dr. Skene lengthens the anterior wall of the vagina, wherever its shortness seems the chief cause of the deformity, by a transverse incision, which is drawn open in the long axis of the vagina and sutured.[3] An elongated, hypertrophied cervix may require amputation.

Anteversion of the Uterus.

Those who believe with Schultze, as the writer does, that the fundus is normally to be found nearly level with the upper edge of the symphysis in the parous woman, in the standing position, with empty bladder, see very little anteversion. It rarely calls for treatment, and little can be done. In cases of inflammation in or about the utero-sacral ligaments, which draws the cervix upward, the same measures are called for that are given in a like condition under Anteflexion. A few cases may be relieved by lifting the uterus on the Graily-Hewitt cradle pessary, but the bladder is subjected to pressure thereby. Occasionally a reef has been taken in the anterior vaginal wall to draw the cervix forward.

Prolapse of the Uterus.

Prophylaxis.—After parturition and abortion weekly bimanual examination of the uterus until it has regained its proper size, pre-

[1] Winckel, *Diseases of Women.*

[2] Skene, *Diseases of Women;* Mundé, *Minor Surgical Gynecology;* Winckel, *Diseases of Women.*

[3] *Diseases of Women,* p. 66.

vention and repair of injuries to the pelvic floor, and prompt treatment of subinvolution and retroversion, will prevent this grave displacement.

Pessaries are indicated where the pelvic floor has not been injured. They are not adapted to prolapse of long standing (atrophy of perineum), to prolapse already treated with inefficient pessaries (incurable relaxation of vagina), to cases complicated with lacerations of the pelvic floor, or to cases one cannot watch.[1]

Brandt's Method.—The most remarkable successes scored by the Swedish gymnast have been in this field. His treatment consists in elevating the uterus after reposition, in massage, and in certain gymnastic movements. His method is indicated especially in the younger women, whose tissues have not permanently lost tone and atrophied, and it is only indicated after operative repair when there is serious laceration of the pelvic floor. Surgery restores the tissues, and these gymnastics restore the tone. It is likely to fail in old or debilitated patients who have no power of reaction, or where marked laceration of the pelvic floor has occurred, or where the vagina has been dilated by pessaries until its walls are atrophied. It is contraindicated in pregnancy, highly-resisting adhesions, fixations of the ovaries, and acute inflammations.

Before beginning the local treatment the patient stands bending forward, resting her hands for support on a table, and a light *tapottement* is performed *upon the sacrum*. These movements should be repeated less frequently when there is hyperæmia of the pelvic organs than when there is a condition of anæmia, as in amenorrhœa, atrophy of the uterus, etc. They are done by the fist. Light tappings of short duration cause contraction of the vessels, but if prolonged a considerable vascular dilatation results. During menstruation these tappings are contraindicated, because they augment the flow of blood. In a condition of prolapsus, tapottement causes contraction of the vessels and stimulates the pelvic nerves.

FIG. 68.

Tapottement (J. and B.).

ELEVATION OF THE UTERUS.—Brandt's procedure can be best understood from Jentzer. An assistant is absolutely essential. One attempting alone to seize and elevate the uterus may not be able to get down between the symphysis and fundus to seize an anteflexed organ, or may drive a retroverted uterus deeper into the pelvis. The physician, with a finger of the left hand in the vagina, replaces the uterus in a normal (anteverted) position, lifting it well up. Then with his right hand he gently presses the abdominal wall downward behind

[1] Schultze, *Displacements*, p. 197.

the symphysis, but in front of the strongly anteverted fundus. The object of this is to give enough slack of skin to allow of the subse-

FIG. 69.

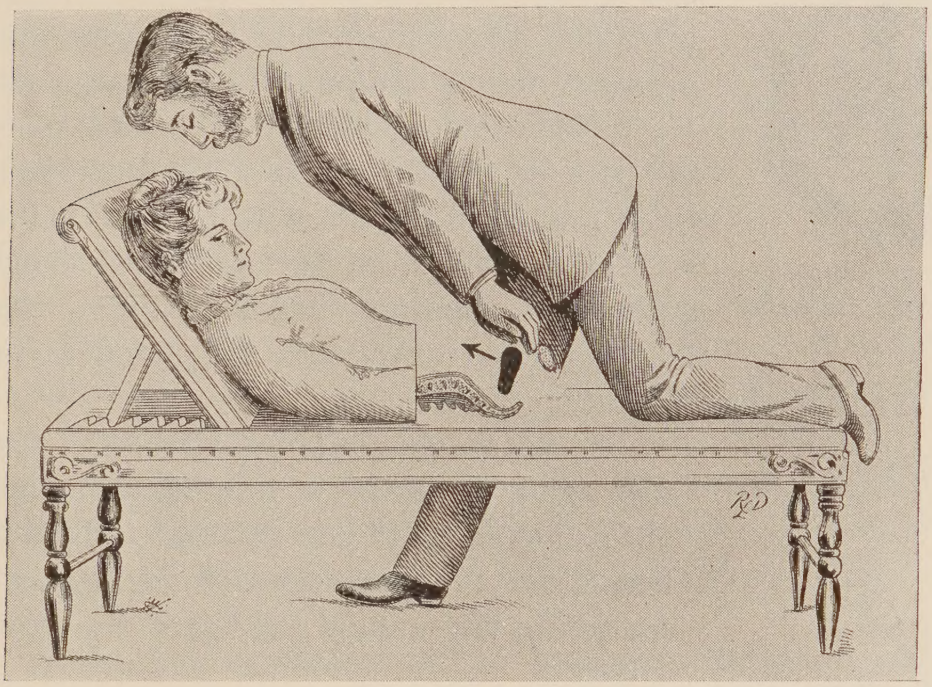
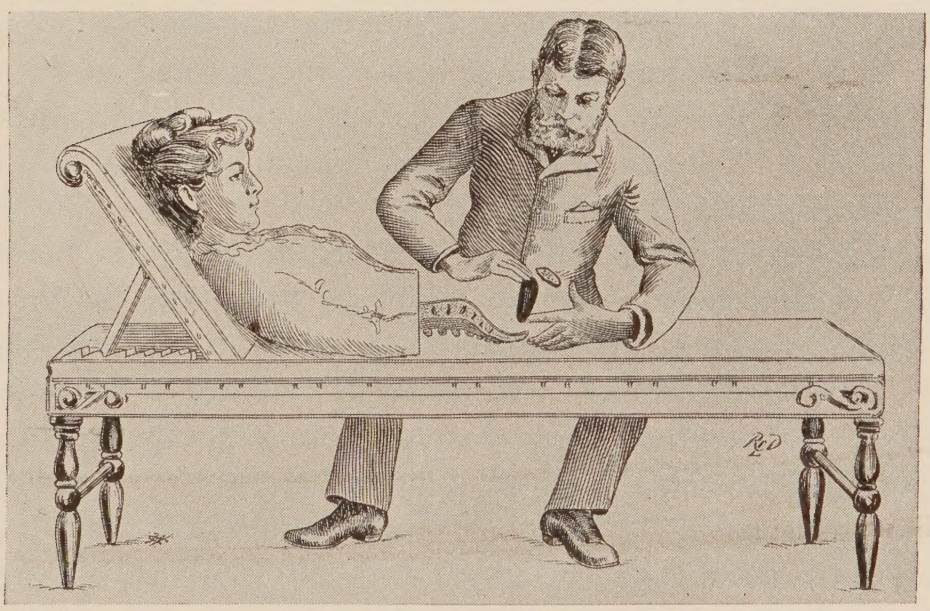


FIG. 70.



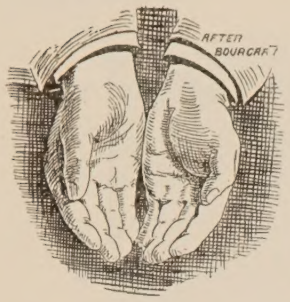
FIGS. 69, 70.—Elevation of the Uterus in Prolapse. The physician replaces and lifts the uterus, while the assistant reaches into pelvis to catch it.

quent lifting. The assistant elevates the uterus. Standing at the foot of the couch, he slips a hand under each knee of the patient and bends her hip-joints at a right angle. He rests one of his knees on the lower end of the couch, while the foot of the other leg is well advanced along the floor at the side of the couch, and the bent extremities of the patient press against his pelvic region, her knees well apart, her feet together.[1]

[1] Profanter is incorrect, according to Brandt, in directing the physician to do the lifting and in directing a grasp of the uterus directly in front, where the round ligaments are in the way. (See also Reibmayr, *Unterleibs-Massage*, Leipzig, 1889.)

He bends forward over the patient; his arms are straight; the finger-tips of both hands are near together; they sink into the pelvis between symphysis and uterus and grasp the uterus, not too low down, laterally, and raise it very slowly up past the promontory, drawing it upward in an arc corresponding to the curve of the pelvis. This should give no pain or discomfort to the patient, and when the uterus has been raised to its maximum height it should glide from the assistant's hands very gently and slide back into the cavity. Any sudden movement would give the patient severe pain, owing to spasmodic contraction of muscular fibres.

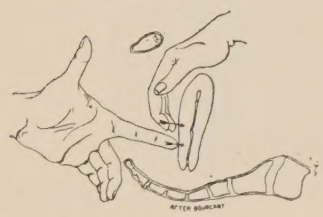
Fig. 71.



Position of Hands in seizing the Uterus (J. and B.).

As the uterus sinks into the pelvis the physician again maintains it in anteflexion, and all of the surrounding tissues contract to hold it there. Sometimes the contraction of the vagina is very markedly felt around the tip of the physician's finger.

Fig. 72.



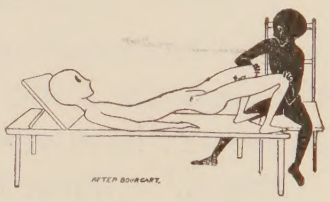
The Uterus pushed upward by the physician's finger below and the assistant's hands above when the lateral grasp of the organ is impracticable (J. and B.).

This operation should be performed gently at the beginning of the treatment, and repeated two or three times during each visit. In the intervals between the upward stretchings the physician passes his index finger, by slow circular movements, from the fundus uteri toward the internal orifice, in order to lessen the passive hyperæmia by causing slight contractions which empty the dilated veins. By this means the diminution of the volume of the uterus is sometimes considerable, and even appreciable by the sound. The treatment may be followed by massage of the utero-sacral ligaments. At the least indication of pain evinced by the patient there must be immediate diminution of the pressure or tension. The physician must never lose control of the position of the uterus, and must not allow the assistant to grasp it improperly, as it is often very difficult, from the outside, for the assistant to be certain of the position of the organ when it is to be drawn up. No grease of any kind should be used on the abdomen or on the operator's hands either while replacing the uterus in the massage of exudates or stretching of adhesions, etc. It is better to work outside a chemise or sheet, that the hands may be less likely to slip on the abdominal integument.

A "knee-resistance" movement is given by Brandt after this operation to strengthen the muscles of the floor of the pelvis, the levator ani, the abductors and adductors of the thigh. The patient, still recumbent, raises her buttocks by supporting herself on her elbows and the soles of her feet (Fig. 73); her knees, which had been sepa-

rated, are then approximated against resistance from the operator. This exercise is given three times; then its reverse, separation against resistance, is tried. Several times during the day the patient should lie down, cross her feet, and alternately contract and relax the levator ani muscle in order still further to increase its strength. After the abduction and adduction of the knees the patient should rest for five or ten minutes in the knee-elbow or lateral position, having turned gently without rising. In this position she respires from the thorax alone, the intestines slide downward and forward, the pressure in the pelvis becomes almost *nil*, and the now anteflexed uterus will remain in position. While taking this rest gentle tapottement is made upon the sacrum. Should the patient resume the erect position immediately after the treatment, the abdominal walls and diaphragm would suddenly contract and the intestines would crowd the uterus downward and backward out of its normal position.

Fig. 73.



Knee-resistance Movement (J. and B.).

The mechanical excitation of the muscular fibres of uterus and vagina, of the ligaments, arteries, veins, lymphatics, and peritoneum of the pelvis, is followed not only by an irritation starting from the spot stimulated and extending much farther, but by actual contraction of every fibre. The contractility of the unstriated muscle is much more slowly produced than of the striated, but the contraction is of incomparably longer duration. There can be no doubt that the pelvic peritoneum exercises a decided influence upon the position of the uterus. It covers the fundus uteri, its sides, and its whole suspensory apparatus; this and the coats of the vessels contain smooth muscle-fibres.

If at the end of two weeks the uterus does not remain in place, Brandt gives up all hope of cure. He obtains from 70 to 80 per cent. of successes. The duration of treatment varies from four to eight weeks, depending upon the chronicity of the case.

Operation.—Where distinct laceration or atrophy of the pelvic floor exists operation affords the only relief. In aged, infirm, or diseased patients it is not advisable. The various merits of these procedures are beyond our scope. They may be indicated as follows:

1. Amputation of the lower end of the uterus when it is elongated.
2. Narrowing of the vulva; forming a barricade which is useless, because it yields in time.
3. Narrowing of the vagina (colporrhaphy); often efficient.
4. Combination of the above methods; the most satisfactory and popular, with numerous variations.
5. Shortening the round ligaments; usually combined with operations on the pelvic floor.

6. Peritoneal fixation of the uterus by laparotomy; dangerous.
7. Extirpation of the uterus; reserved for the most extreme cases.

Fibroid Tumors of the Uterus.

The treatment of uterine fibromata is still in an unsettled state. Although the knife is in fashion, medical treatment, the curette, and electrolysis have advocates among the strongest men.

Ergot.[1]—When the tumor is of moderate size and situated in the uterine wall or beneath the mucous membrane, so that it is "surrounded by layers of muscular fibre sufficiently developed to be capable of being excited to contraction," we find conditions under which ergot may be expected to relieve the symptoms, check the growth of the tumor, and sometimes to cause shrinkage. It acts "by checking the nutrition through diminution of the blood-supply and by favoring pedunculation and expulsion: these are both due to its action on the unstriped muscular fibre of the walls of the uterus and coats of the blood-vessels."[2] A large number of cases are on record where arrest of growth and of hæmorrhage and diminution in size has occurred, and in some cases very large tumors have grown small, and even subperitoneal fibroids have dwindled. The method has warm supporters[3] and vigorous detractors,[4] but it deserves a persistent trial in the cases specified. The most speedy and sure results are obtained by the hypodermic use of the drug. The officinal extract of ergot of a trustworthy maker (as that of Squibb) is as good for hypodermic use as Bonjean's ergotin; its strength is five times that of the fluid extract, and in all respects it represents the drug therapeutically:[5] 3 to 4 grains are dissolved in 5 minims of glycerin and 10 of water and a ½ minim of carbolic acid, and filtered (or salicylic acid, 1½ grains to 1 ounce of the solution, preserves it). Parke, Davis & Co.'s normal liquid ergot causes no irritation hypodermically (15 to 30 minims). The ergotole of Sharp and Dohme is highly praised in an elaborate experimental study by Hemenway.[6] Squibb's fluid extract must have the acetic acid driven off by evaporation and the bulk restored with distilled water before it can be used. Its dose is the same. The injection is made in any muscular mass like the gluteal or deltoid region by plunging the needle at right angles to the skin deeply into the muscle, the point entering from an inch to an inch and a half. The places selected are used in rotation. Some hours after the injection

[1] Hildebrandt, the originator, *Berlin. klin. Wochensch.*, 1872, No. 25.

[2] Ringer, *Brit. Med. Journ.*, Jan. 19, 1884.

[3] Byford, *Trans. Amer. Med. Ass.*, 1875.

[4] Summary of results by different authors, Schorler, *Zeitschr. f. Geb. u Gyn.*, 1884, xi. p. 160. See also Winckel's *Diseases of Women.*

[5] H. C. Wood, *Therapeutics.*

[6] *Med. News*, Philada., Mar. 7, 1891.

uterine pain may be produced, and possibly pallor, coldness, and slow pulse, with cramps in the extremities, but the latter symptoms are rarely caused by 7 grains or less, and many patients stand very large doses, so that moderate uterine pain commonly shows us our upper limit in dosage, and to this limit ergot should be pushed. For the first few weeks the injections may be made twice a week, afterward only once a week. The treatment is continued for several months, until its effect is seen in diminution in the size of the tumor.

The injections may be given by a nurse or attendant or by the patient herself if she can be trusted to clean the needle and syringe, insert the wire, and guard the solution from spoiling. With such precautions abscess need never occur and the treatment may be kept up for years. The drug may be given by the mouth in the form of fluid extract ½ drachm three times daily, instead of subcutaneously, or in connection with the latter method. Nausea and constipation are sometimes caused by this stomach administration. We are content if we can control the blood-loss and growth and keep the patient in comparative comfort until her menopause.

Hydrastis.—The fluid extract of golden seal, in doses of 10 to 20 minims, three times a day, ranks next to ergot in power to control the bleeding. The disagreeable taste is overcome in the liquor sedans of Parke, Davis & Co., which contains also viburnum and piscidia, and acts well in my hands. Hydrastinin, in ½-grain pills, or doses of 1 to 2 grains subcutaneously, is said to bid fair to displace the fluid extract when its cost diminishes.[1] Hydrastis is less likely to disturb the digestion than ergot, and in many cases the fluid extract improves the condition of the alimentary tract. Bromide of sodium is of much value in doses of 10 grains, three times daily, continued for months, to diminish the neuralgia and dysmenorrhœa. Vichy renders it palatable. Cannabis indica, 3 to 5 minims of a trustworthy tincture, two or three times a day, acts well with the bromide: it is first rubbed up with mucilage of acacia to carry it in the solution. Phenacetin in 10-grain powders, suppositories of extract of belladonna or of hyoscyamus, ¼ grain each, or of chloral, 5 to 15 grains, are used to combat pain, and morphine is withheld as long as possible. The opium habit should not be formed in a disease of this slow character if it can possibly be avoided. Pain may sometimes be relieved by an Emmet pessary, which will lift a uterus that is burdened or displaced by a small fibroid; and with larger tumors the flannel abdominal binder may carry some of the weight. Moreover, when a mass nearly fills the pelvic cavity we persistently push it out of the pelvis, or see that the patient drops it out by assuming the knee-chest position, thereby lessening pressure-symptoms and the chances of adhesion (Hart).

[1] *Deutsche med. Wochensch.*, 1891, No. 47, 1283.

The Curette.—When ergot and hydrastis fail to check the bleeding our next resource is a simple operation, of great utility where the canal is not too tortuous or deformed. Vascular growths, called uterine fungosities, are the direct source of the hæmorrhage. These the curette removes. The operation may be repeated whenever the hæmorrhagic tendency returns. In conditions where no growths are found by the curette the dilatation with the Ellinger dilator and the scraping of the cavity will have been done with advantage, because the dilatation is of itself valuable (Baker Brown), and because, if the bleeding persists, a good preparation has been made for a styptic application.

Intra-uterine Applications.—Perchloride of iron or tincture of iodine is best injected into the cavity of the uterus by Skene's instillation tube. The vagina is protected by a swab, and the surplus and débris may be washed out of the uterus afterward by a two-way catheter. The method is safe if we bear in mind that gentleness is required on account of possible dilatation of the tubes (Pozzi).

The Tampon.—Sudden or profuse hæmorrhages must be checked by the tampon, and in many cases can be checked by the tampon alone.

Regular hot-water vaginal injections, provided they range between 110° and 120° F., may be of utility in preventing a speedy return of the bleeding.

Iron and Tonics.—Between the menstrual periods the patient must be built up by food, wine, regulated feeding, iron, and tonics as much as possible.

Electrolysis.—Cutter,[1] who first used electrolysis for fibroids, advocates puncture of the tumor by needles, and reports excellent results; but the less rapid and efficient, but safer, method of Apostoli has supplanted it except where the uterine canal is impervious.

Danion[2] claims better results than Apostoli's with currents of 45 to 65 milliampères, rarely rising to 90. He introduces an electrode into the cervix only, or more frequently still depends on a large vaginal tampon electrode. He insists on frequent reversal of the current by means of the pole-changer (turning the current off with the regulator before a change, then turning the reversed current on). Inasmuch as this method entails none of the dangers of the method of Apostoli, and emanates from high authority, it claims a trial first. Keith is said by his son to use low currents also.

Apostoli[3] claims a shrinkage of the tumor of one-fifth or one-third, very rapid and permanent arrest of hæmorrhage, and disappearance of

[1] *Am. Journ. Obstet.*, 1878, p. 113. [2] *Bull. Soc. de Chir.*, 1889, p. 473.

[3] *Comptes rendus Congrès franc. Chirurg.*, 1889; see also Engelmann, *Med. News*, May 14, 1886; Keith, *Brit. Med. Journ.*, 1887; Grandin and Gunning, *Electricity in Gynæcology*, New York, Wood, 1891.

pressure symptoms in 95 per cent. of his cases, with a death-rate of zero under proper precautions. The permanence of these results is still on trial, but arrest of hæmorrhage, growth, and pain are claims that are evidently just. Electrolysis must always be faithfully tried before hysterectomy. Keith says it is criminal to omit it.

The outfit consists in a fifty-cell battery (Law cells), a milliampèremeter to measure the dosage (Barrett meter), a current regulator to ensure gradual increase of the current (the Bailey or Gunning model), and the electrodes. The external electrode is made of the clay used by sculptors in modelling, enveloped in gauze, oval in shape, and of a size sufficient to cover the larger part of the abdomen—four to ten inches in diameter. To make it the dry clay is broken up into walnut-sized pieces, well wetted, and left over night to soften. Then it is worked with the hands to the consistence of putty and spread half an inch thick on gauze. It is kept rolled up in wet flannel and an impervious covering, like table oil-cloth or rubber, to prevent drying. Before using, the roll of clay and flannel is dipped into very hot water until warmed throughout. Then it is fitted to the abdomen, with the metal plate that backs it made fast, and the cord securely tightened at the binding-post. The internal electrode is a gold, platinum, or a cheaper (Gunning) sound insulated to within a short distance of its point, which is inserted, if possible, into the uterine canal. Otherwise a needle, insulated within a quarter of an inch of its point, is pushed into the tumor. All connections being found tight, the current is slowly turned on, stopping whenever the patient complains, and continues five minutes, using 50 to 100 milliampères at first, later rising to 200 or 250. Any break in the circuit would give a fierce shock. The process is repeated two or three times a week, and then once a week from six to nine months. When hæmorrhage is to be checked, Apostoli injects the uterine cavity full of gelosin, into which the electrode is passed. This is a mucilaginous paste made of a Japanese seaweed, easily made aseptic, and ensures a uniform cauterization of the mucous membrane. The intra-uterine bipolar electrode of Apostoli avoids the use of wet clay on the abdomen.

Operations.—Skene, Keith, Schroeder, and Winckel give very solemn warning against the recent infatuation for operation. They insist that in this self-limited disease, that rather torments than kills, every other means demands trial, and that only where hæmorrhages are uncontrollable, the progress rapid, with cystic or suppurative changes, the health ruined or life endangered, can an abdominal operation be justified as long as the mortality in the hands of the famous operators runs as high as it now does, 20 per cent.,[1] even though, very rarely, a surgeon like Keith may go down to 8 per cent.

[1] Pozzi, *Gynécologie*, Paris, 1890.

The more important methods are merely mentioned:

1. Fibroid polypi. These are removed by écraseur or scissors, or, when too large, cut away piecemeal until the pedicle is accessible.

2. Cervical, submucous, and intramural fibroids are sometimes removed through the vagina by enucleation.

3. Larger, higher, and subperitoneal tumors are removed by laparotomy, with or without removal of the entire uterus.

4. Removal of ovaries to produce an artificial menopause.

Cancer of the Uterus.

Our resources in carcinoma and sarcoma are almost entirely surgical, although condurango, Chian turpentine, and alveloz have been extolled as cures and discarded or discredited. Brief mention of the procedures chiefly trusted is all that the scope of this work allows:

(*a*) Where the cervix only is involved:

1. Removal of all diseased tissues by the cutting curette, followed by zinc chloride or the cautery for the earliest cases, chiefly when the canal only is affected.

2. High amputation by the knife, followed by the cautery (Schroeder).

3. Amputation by galvano-cautery (Byrne).

The first is usually insufficient; the two latter score many cures if done before the disease is advanced beyond removable tissue (Byrne, 53 per cent. exempt over two years).

(*b*) Where the body of the uterus is attacked, but the disease is restricted to the uterus, the organ being freely movable and without suspicious infiltrations or glandular enlargements in its neighborhood:

1. Extirpation by laparotomy (Freund's operation) is unjustifiable, because of the mortality, over 70 per cent., and the frequency of recurrences.

2. Vaginal extirpation. The mortality has been high, 26 per cent., but is lowering considerably. Immunity after two years in from 20 to 33 per cent. are the most brilliant reports in the hands of the best operators.

3. The galvano-cautery (Byrne), 35 per cent. immunity over two years, the safest and most remarkable showing yet.

(*c*) Where the disease involves tissues outside of the uterus operation is unjustifiable, and we may only resort to symptomatic treatment:

1. Temporarily to improve the condition of the affected surface. While the curette and the galvano-cautery probably take first rank for this purpose, nitric and chromic acids and zinc chloride (saturated solution) have been used, and, more recently, milk of alveloz. No cure can be expected from the last over-praised drug, but there is satisfactory testimony to its effect in a certain number of cases of spongy, easily disin-

tegrated cervices in producing a healthy-looking surface and diminishing the discharge.[1] It is applied with a soft brush to the previously dried surface, covered with cotton and rubber tissue. As with other caustics, the vagina requires most careful protection. Alveloz is said to be less painful than the other caustics.

2. To relieve pain. Opium or morphine by vaginal or rectal suppository, by hypodermic injection, or by the mouth is given in sufficient doses to render the patient comfortable, and given to the extent of forming the opium habit if necessary. Codeine, $\frac{1}{4}$, $\frac{1}{2}$, or 1 grain, may be tried at first, and chloral, cannabis indica, or bromide may assist the action of the opium group. It is well sometimes to change from one to another of the various ways of giving opium.

3. To check hæmorrhage. Very hot injections—110° to 120° F.—vinegar injections, or applications of perchloride of iron to the bleeding surfaces, or the tampon, will arrest moderate bleeding. When it is profuse and otherwise uncontrollable the softened tissue must be curetted away with the sharp instrument, and the considerable hæmorrhage that usually follows must be checked by the cautery.

4. To remove the fœtor of the discharge. Vaginal injections of permanganate-of-potassium solution of the color of port wine, or solution of chlorinated soda or potash 1 to 10, are usually efficient. Iodoform tampons are objectionable in odor. Hot douches of zinc sulphate or alum, 1 drachm to the pint, diminish the amount of the flow.

5. To improve the general condition. Relief of vomiting or pain, forced nutrition, wine, tonics, and careful regulation of the bowels by enemata or mild laxatives, require special mention.

[1] Hunter, *Med. Rec.*, July 11, 1887.

AMENORRHŒA, DYSMENORRHŒA, MENORRHAGIA, AND STERILITY.

By HUNTER ROBB, M. D.

AMENORRHŒA.

Amenorrhœa is an absence of the periodical monthly flow in a woman during the menstrual period of life, due to whatever cause. "Physiological amenorrhœa" is a term applied to the cessation of menstruation during pregnancy and lactation. The term amenorrhœa is also employed when there is a failure of the menstrual secretions to escape externally, as in the case of retention in the uterus or in the uterus and vagina. These cases are designated hæmatometra and hæmatokolpos.

The term "amenorrhœa" was accepted at one time by the profession as the name of a specific disease. Popularly, and by a large part of the medical profession, absence of menstruation is looked upon even to-day as a specific, well-defined disease. The more advanced members of the profession, however, now recognize under this heading a symptom common to a variety of diseases, classified and properly treated according to their varying causes, which are—

A. Defective development of the generative organs;

B. Mechanical obstructions due to—

(*a*) Congenital occlusion of the cervix and vagina;

(*b*) Acquired occlusions of the cervix or vagina;

C. Constitutional diseases, such as chlorosis, phthisis, malaria, syphilis, insanity, etc.;

D. Amenorrhœa due to diseases of the Fallopian tubes and ovaries.

A. **Defective Development of the Generative Organs.**—Cases of this character are rare. Treatment should first be directed to the general hygienic condition of the patient and systematic muscular exercise enjoined. Massage of the abdominal walls, and in exceptional cases of the uterus and its appendages, is of value. Electricity to the uterus and abdomen may be used to stimulate the circulation of the pelvic organs; Churchill's tincture of iodine, applied to the cervix and vault of the vagina every two or three days, followed with a 50 per

cent. cotton boro-glyceride tampon; douches of warm water at a temperature of 112° F.; 1 litre (1 quart) may be given night and morning, slowly injected. This local treatment may be combined with the internal administration of arsenic or quinine, and laxatives for intestinal inactivity should be given.

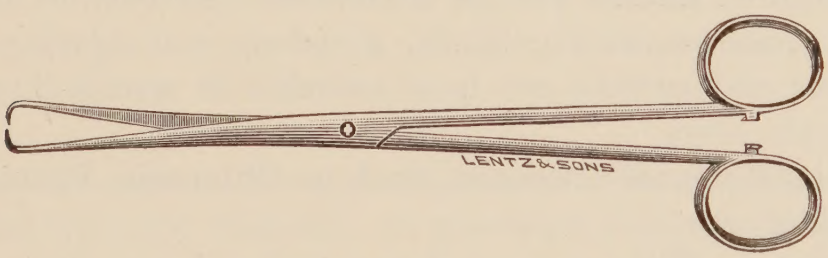
The object of this treatment is thus twofold in cases of markedly under-developed organs by exercise, etc.: to divert the attention of the nerves and relieve the molimina, although no hope can ever be entertained of establishing the absent function. Where the organs have stopped but little short of complete development the treatment may bring about a normal regular menstruation. In case of infantile or rudimentary organs no treatment should be undertaken.

B. **Mechanical Obstructions due to** (*a*) Congenital occlusion of the cervix and vagina; (*b*) Acquired occlusion of the cervix or vagina.

(*a*) Congenital occlusion of the cervix or vagina is among the rarer causes of amenorrhœa.

When the cervix is closed, thoroughly cleanse the vagina with soap and water, and irrigate with a 1 : 3000 aqueous solution of bichloride of mercury at a temperature of 100° to 110° F., ½ litre (1 pint), following this with warm distilled water; then expose the cervix by catching it with a tenaculum or a pair of light bullet forceps, while the posterior vaginal wall is depressed by a Simon's or Sims's speculum. (See Fig. 74.)

Fig. 74.



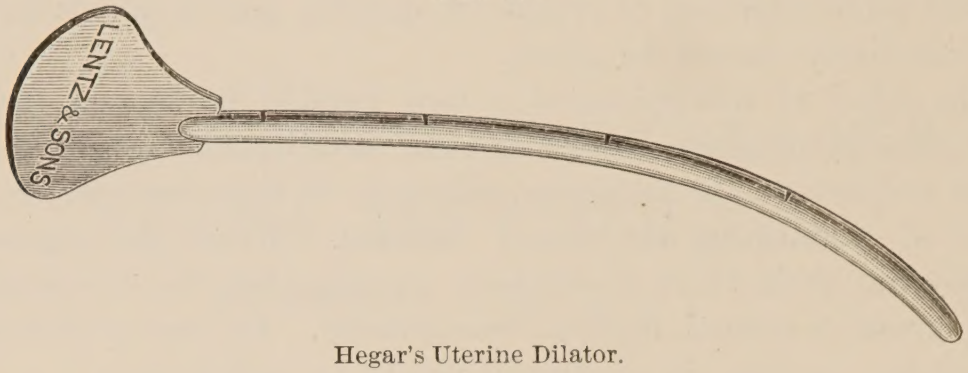
Short Bullet Forceps for holding cervix uteri.

The attempted introduction of a uterine sound through the cervix will at times be sufficient to break through the occlusion and at once allow the escape of the accumulated fluids. If a dense membranous tissue occludes the cervix, use a spear-pointed tenaculum or a delicate-bladed scalpel to perforate the membrane, controlling its movements by a finger within the rectum. After this complete the dilatation by introducing a graduated sound or a Hegar dilator (Fig. 75).

If the vagina is closed by an imperforate hymen, it is best punctured through the central portion, and then made sufficiently large by an aseptic finger or by the dilator to allow any accumulated menstrual fluid to escape. This operation is better performed under general anæsthesia: however, it can be safely undertaken by the local anæs-

thetic action of a 10 per cent. solution of cocaine given hypodermically. The perforation of the hymen or any other membrane closing

FIG. 75.



Hegar's Uterine Dilator.

the vagina may also be accomplished by the use of Paquelin's cautery. This is not to be recommended so highly as the knife, as it may leave a sloughing surface. It is of the highest importance to avoid secondary infection in these cases, which is likely to prove fatal. Avoid this by performing the operation in as aseptic a manner as possible, and afterward guard the vaginal entrance by frequent applications of a powder of iodoform and boric acid (1 : 7) and a vulvar pad consisting of a 10 per cent. iodoform or a 1 per cent. permanganate-of-potassium gauze, against which a layer of sterilized absorbent cotton is placed. This dressing is held in position by a well-fitting T-bandage.

(*b*) Acquired atresiæ due to traumatism can only be relieved by operative measures, cutting bands, stretching and dilating the parts. The dilator and currette are most valuable in atresia due to cancer of the cervix uteri.

C. **Constitutional Diseases, such as Chlorosis, Phthisis, Malaria, Syphilis, etc.**

CHLOROSIS.—The treatment of amenorrhœa here is the treatment of the disease chlorosis. Systematized hygienic regulation of the bodily functions is necessary. The internal administration of iron is useful, in the form of the tincture of the chloride, 2 drops three times a day, increasing a drop a day at each dose until 5 or 6 drops are taken each time. Basham's mixture, in doses of 2 to 4 tea-spoonfuls three times a day, or Blaud's pills, 5 grains three times a day for long periods of time, are especially valuable. The question of the tolerance of the administration of iron should be decided by its action upon the digestive organs. The preparations of arsenic are of great value: Fowler's solution in doses of 3 to 6 drops, when tolerated, three times daily; the solution of the chloride of arsenic is also of value, 3 to 5 drops three times daily.

PHTHISIS.—It must be borne in mind that the amenorrhœa in phthisis is often a conservation of a fluid which the economy can

but ill afford to spare. The treatment ordinarily carried out for phthisis is essential. I have seen a case progress well under the local stimulating application of Churchill's tincture of iodine three times a week to the endometrium, and packs of boro-glyceride to the vaginal cul-de-sac and the fornices.

MALARIA.—Internally, quinine, arsenic, and preparations of iron should be given. Iodine (Churchill's tincture) should be applied to the fundus, and the vaginal fornices should be packed with boro-glyceride tampons.

SYPHILIS.—Mercury and iodide of potassium, which cure the syphilis, also usually cure the attendant amenorrhœa.

D. **Diseases of the Tubes and Ovaries.**—Churchill's tincture of iodine should be applied to the vaginal fornices; or nitrate of silver, 20 grains to the ounce: after applying either of the above, boric acid and glycerin, a 50 per cent. solution, can be applied by means of cotton tampons so as to come as closely in contact with the diseased structures as possible. Douches of hot water, ½ to 1 litre (1 pint to 1 quart), should be used twice daily while the patient is in the recumbent position; this should be administered slowly; the temperature should not be above 108° to 112° F. The applications may be made two or three times a week for several months as long as benefit is derived; the douches are best continued every day for two or three weeks, then stopped for a week, beginning again, if the symptom is still unrelieved, every other day for a week. After this the douche may be given daily again for three or four weeks. If benefit is to be derived from this treatment, it should be apparent in three to four months.

In these affections of the appendages amenorrhœa is thus sometimes noticed, and is usually transient. If associated with other serious symptoms warranting operation, the removal of the diseased tube or ovary will at times have the effect of restoring the patient to health, although of course establishing a permanent amenorrhœa.

DYSMENORRHŒA.

DYSMENORRHŒA is no longer considered a pathological lesion *per se*. It is always secondary and symptomatic and the result of a definite cause. Dysmenorrhœa is also a term which has been, and unfortunately is still, much abused by the profession, and long lists of drugs are in vogue prescribed for dysmenorrhœa as a disease. It is, however, essential for us to treat the cause of the dysmenorrhœa if we are to expect beneficial results. Its frequency as a symptom covers, with

few exceptions, all pelvic disorders. Few women are free from some distress at the time of their menstrual period, but slight discomfort is not classified as dysmenorrhœa.

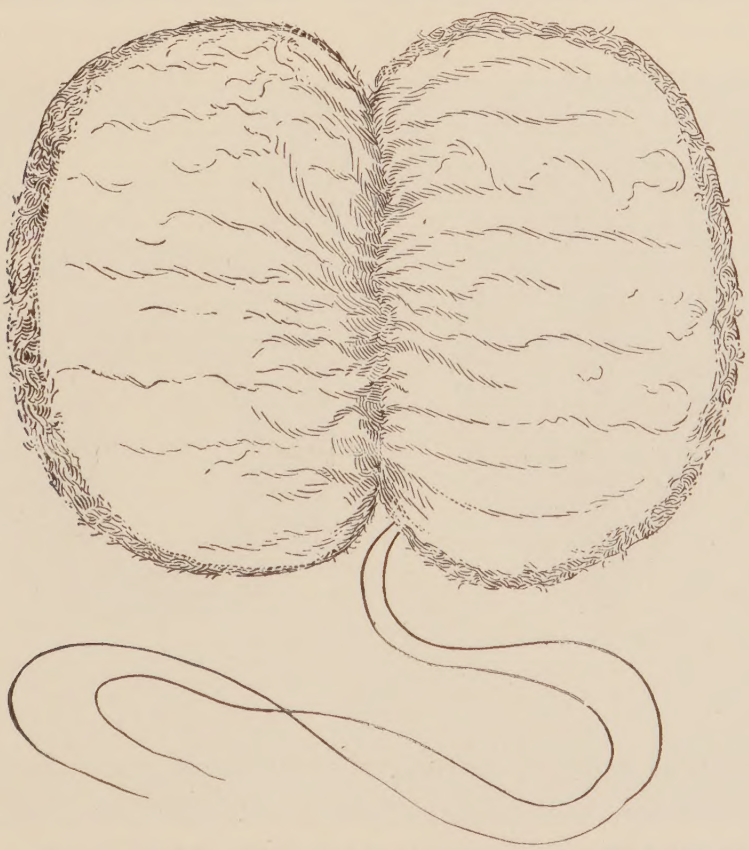
We will consider the treatment of dysmenorrhœa as depending upon—(1) Congenital defects; (2) Mechanical causes; and (3) Diseases of the Fallopian tubes and ovaries.

(1) **Congenital Defects.**—An undeveloped condition of the uterus, tubes, or ovaries will often occasion painful menstruation. Treatment of this is a hygienic régime, combined with the administration of general tonics. Exercise in the open air, guided by the effects obtained, is of value. The use of internal medication, such as Fowler's solution of arsenic, given in increasing doses, beginning with 2 drops and adding 1 drop to each dose until 5 or 6 drops are taken three times daily, is also advisable. Correctives should be used for any dyspeptic derangements, which are apt to be intimately associated with dysmenorrhœa.

(2) **Mechanical Causes.**—Retro-displacements and sharp anteflexions of the uterus are the most fruitful sources of dysmenorrhœa. The treatment is necessarily directed to the employment of means for relieving the malpositions, as by a well-fitting pessary, either a Smith-Hodge or rubber ring-pessary (Peaslee). Ever bear in mind what the pessary is to accomplish. It is of the greatest importance to recognize the position which the uterus occupies, and if sharply retroflexed or anteflexed the malposition must first be corrected before introducing the pessary; also before applying the pessary we should carefully note the condition of the vagina and the position and thickness of the symphysis pubis. This is most easily accomplished at times under anæsthesia, as it permits free and unrestricted manipulation, which is otherwise often impossible. After the pessary is in position the patient should be asked to bear down while standing upright, and thus ascertain if it will remain in position, is comfortable, and gives the proper support to the uterus. It is advisable to remove the pessary every two or three weeks, as it thus avoids the danger of ulcerating the vaginal walls or of producing any irritating action. It should also be thoroughly cleansed in a 1 : 20 aqueous solution of carbolic acid and dried; the vagina also should be cleansed with a douche of a warm 1 per cent. aqueous solution of carbolic acid and dried with bits of absorbent cotton. The pessary may then be introduced at once, or, what I believe to be a still better plan, not until two days have elapsed, allowing the vaginal walls to regain their tonicity. If this latter procedure is adopted, the uterus in the meantime can be supported by a well-applied boro-glycerin tampon; this also is of advantage, as the parts do not become so dependent upon the pessary, and therefore it does not become altogether impossible for the patient ultimately to dispense

with the artificial support. If a pessary is not efficient, local treatment should then be pursued: for two or three months support the uterus by tampons made of absorbent cotton. Churchill's tincture of iodine may be applied to the vaginal fornices every two or three days, and tampons of absorbent cotton, moistened with a 50 per cent. boro-glycerin solution, placed on either side of and above or beneath the central portion of the cervix, filling up the fornices, and another tampon of cotton wool immediately in front of the cervix to give elastic support. To perform the above manœuvre with facility is not an indifferent accomplishment. It is easily executed if the anterior lip of the cervix is fixed with a curve-pointed tenaculum or, still better, with a pair of bullet forceps: first introduce the index finger of the left hand within the vagina to ascertain the position of the cervix, and then, passing the forceps flatwise along the side or palmar surface of the index finger, the anterior lip is easily caught and readily exposed to view by retracting the posterior vaginal wall with a Simon's or Sims's speculum. The tampons employed may be spread with various antiseptics or astringents, such as 1 : 7 iodoform and boric acid, pure iodoform powder, powdered

FIG. 76.

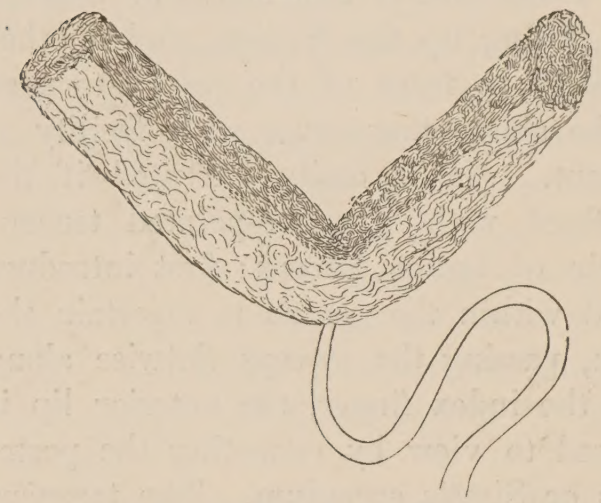


Anterior Surface of Tampon, spread open to receive medicated solution.

alum and boric acid, equal parts or separately. If the tampons are carefully and intelligently applied, they will not produce any discomfort. The smaller-sized tampons are more easily placed in position,

and they must be firmly packed around the cervix to obtain any supporting effect. They are most conveniently made in two sizes, as follows: Take a single layer of absorbent cotton, 12 cm. long and 9 cm. wide, and fold this once lengthwise, so that the thickness of the cotton thus doubled will be 2 cm.; then with a thread or bit of string encircle the crease made by the folding of the cotton; this is then tied by either a single thread with a plain knot or a double thread with a slip noose, making the length of the string about 14 cm. from the knot. This length allows the easy removal of the tampon. The tampon is then trimmed with scissors, forming a circular disk. (See Figs. 76, 77, 78, and 79.) For the smaller size a piece of cotton 9 cm. long and 6 cm. wide is used; this is folded and made in the same manner as the larger size. Tampons made in this manner

Fig. 77.

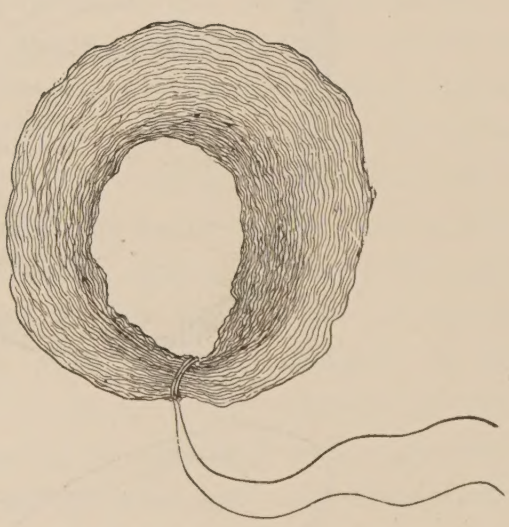


Same as Fig. 76, side view.

Fig. 78.

The Tampon Closed and Ready for Insertion.

Fig. 79.



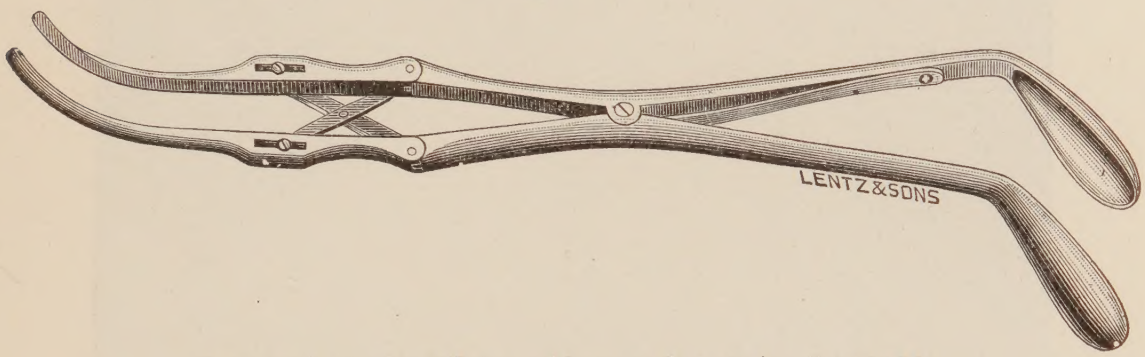
The Round Wool Elastic Tampon.

can be easily separated, allowing any dressing that may be desired to be spread between the layers of the cotton, and then folded together. The cotton-wool or lamb's-wool tampons are made by twisting a piece of wool 30 cm. long and 3 cm. wide around three fingers, so as to form a loop; this is then tied around the loop at one end with a piece of

thread, in the same manner and length as used with the tampons made of absorbent cotton. The wool is then separated, so as to spread it out and obtain the full benefit of its elastic qualities.

Tampons should be removed after twenty-four hours and the vagina thoroughly douched with 1 litre (1 quart) of water as warm as can be borne. The douche should be slowly injected while in the recumbent position, either by a fountain or Davidson's syringe. The application

FIG. 80.

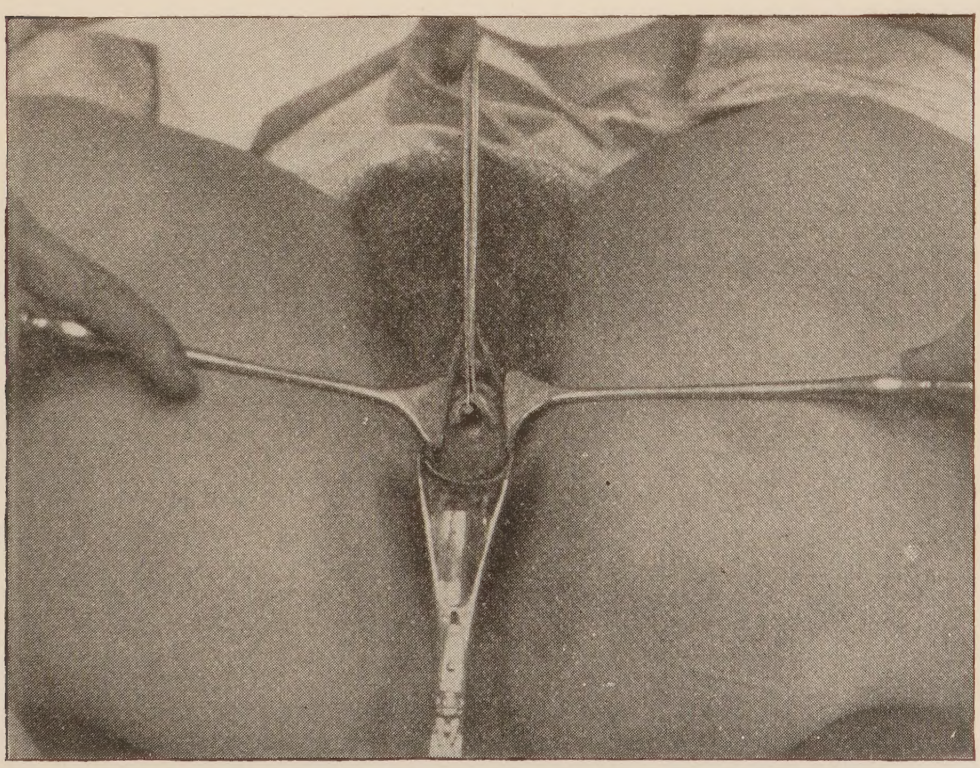


Improved Uterine Dilator, without rachet, spring detachable.

and tampon should be made every second or third day, and at the end of three weeks it is advisable to discontinue, thereby avoiding any ill effects from counter-irritation.

Dysmenorrhœa persisting from displacements of the uterus can be

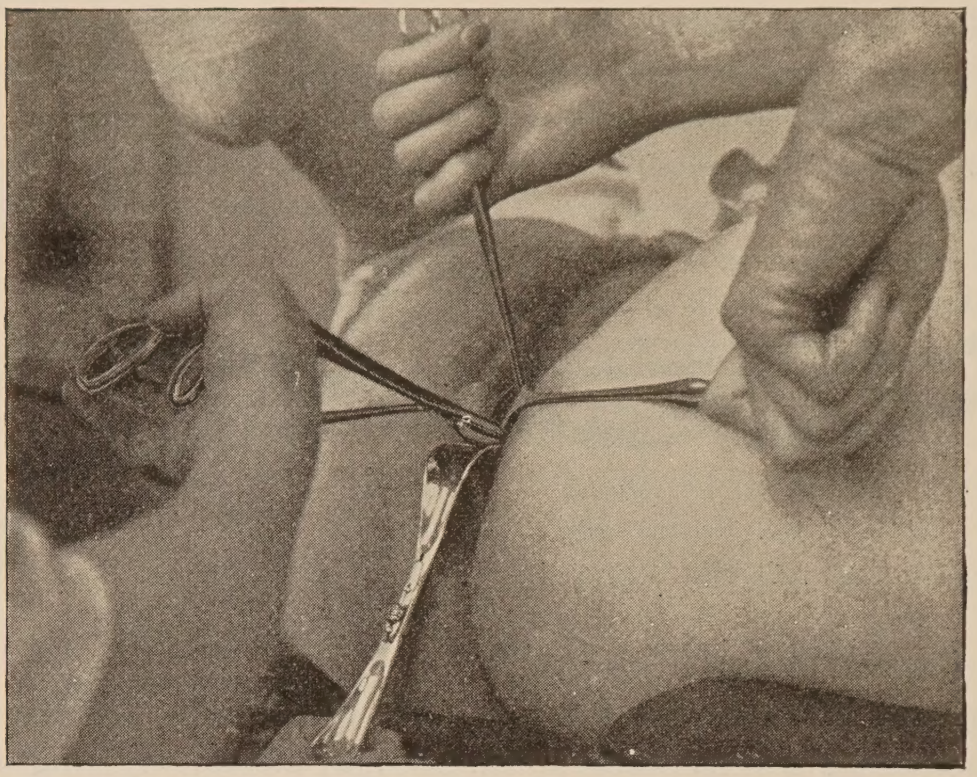
FIG. 81.



Catching the Cervix for Dilatation and Curetting. Below, the writer's speculum retracting the posterior vaginal wall; retractors in each side; above, bullet forceps grasping anterior lip of cervix and holding the uterus artificially displaced downward at the vaginal outlet preparatory to dilatation.

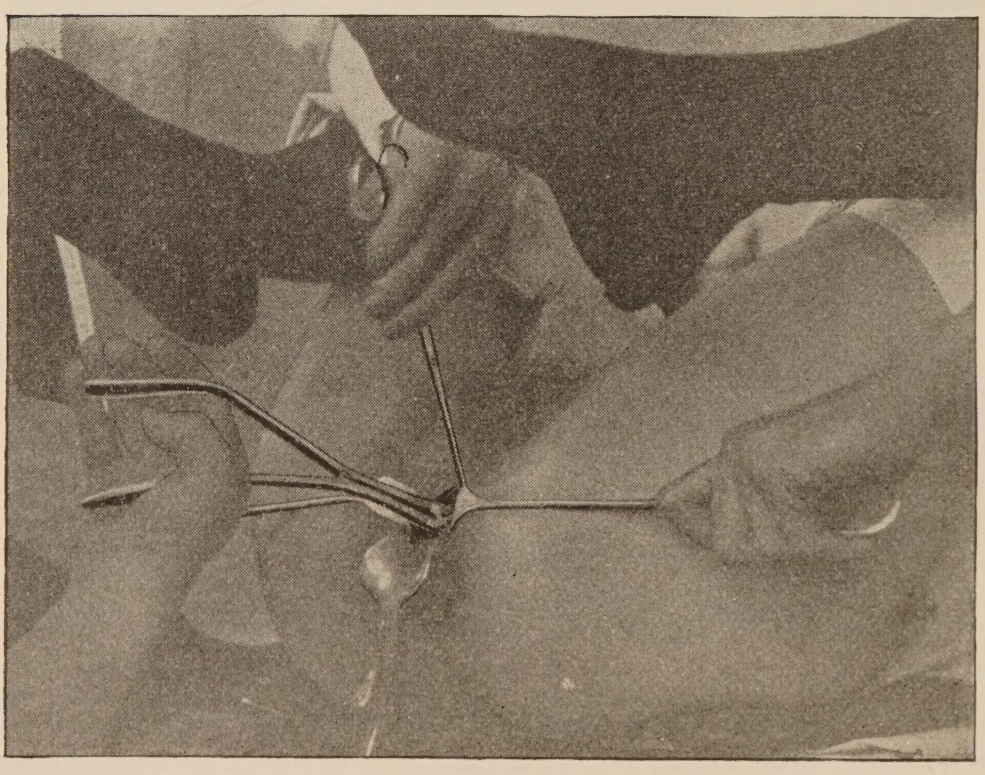
relieved only by operative measures; by carefully dilating the cervix with a modified Ellinger's dilator, or by gently opening the entire

FIG. 82.



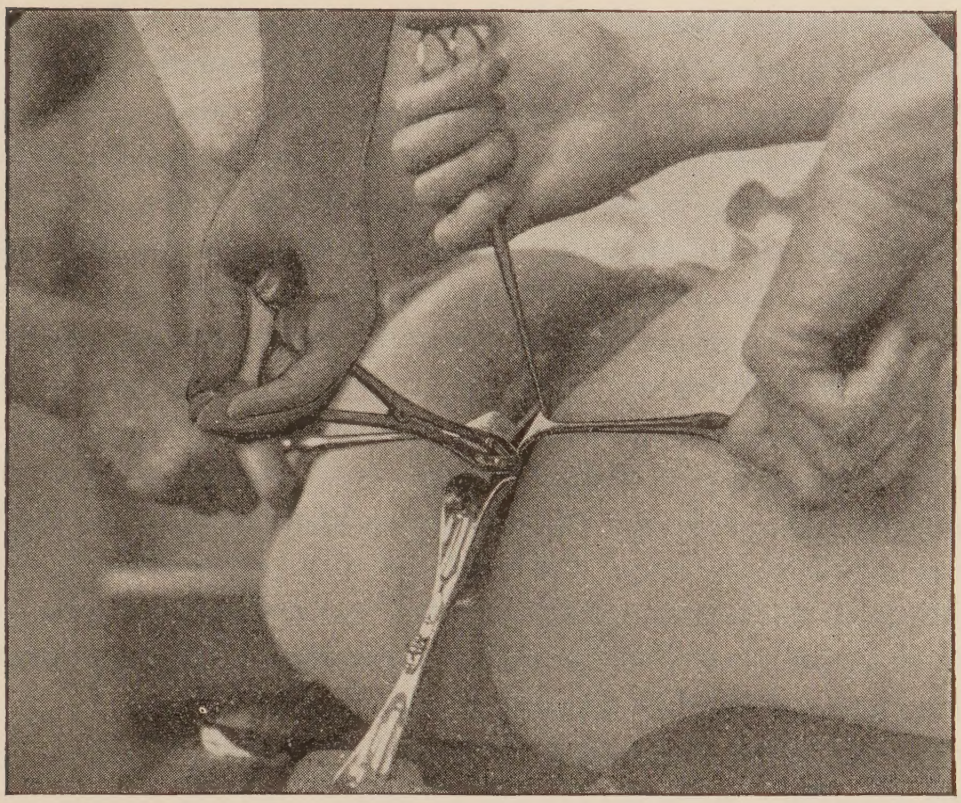
The First Step in the Dilatation of the Cervical Canal. Lateral separation of the lips with the modified dilator.

FIG. 83.



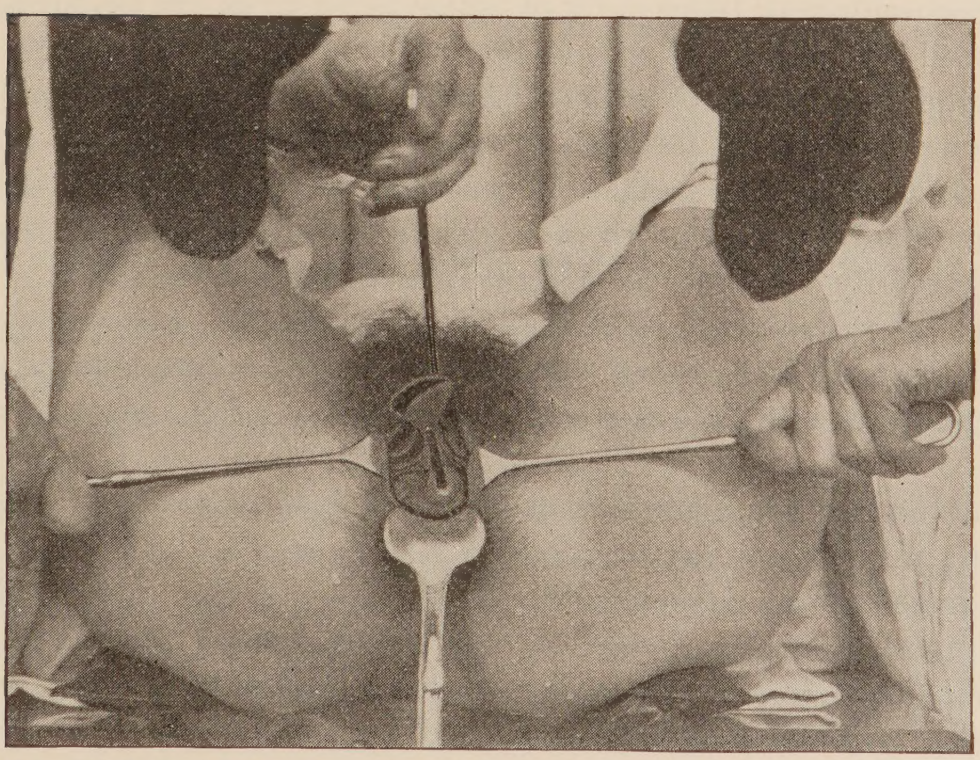
The Next Step in the Dilatation. The dilator is now expanding the cervical canal in a direction halfway between the vertical and the transverse axis.

FIG. 84.



A Further Step in the Dilatation of the Cervix, held as described. The dilator is now engaged in expanding the cervical canal in an antero-posterior direction. Assistant's hand above holds the bullet forceps. The buttocks are shown resting on Kelly's perineal drainage-pad.

FIG. 85.



Preliminary Dilatation of a very contracted Cervical Canal with a Hegar's Dilator. Dilator seen in place in the centre of the figure.

cervical canal by equable all-around dilatation, as if dilating the finger of a glove, as taught by Dr. H. A. Kelly. (See Figs. 80, 81, 82, 83, 84, and 85). This is frequently followed by the most gratifying results, and often for many months afterward allows the woman comfort, doing away altogether with the necessity for other treatment. If dilatation is gently and aseptically performed, it does not produce unfavorable sequelæ. It should never be attempted unless under the strictest aseptic and antiseptic surroundings, observing consistently every precaution in our technique. Rapid dilatation in one direction is objectionable, as it may produce an extensive laceration, which may subsequently become infected. A cervix rapidly dilated is apt to be followed by the formation of scar-tissue in the angle of the laceration.

Thoroughly anæsthetize the patient, as it permits of quicker and more satisfactory work, and in addition it enables us to discover the existence of adherent lateral structures and thus avoid danger. Sponge tents for dilating the cervix are not to be recommended, as they are painful, slow, and not efficient; also the aseptic technique is not nearly so well maintained as with the use of the dilator.

Diseases of the Tubes and Ovaries.—Dysmenorrhœa is a most constant symptom with pathological changes in the Fallopian tubes and ovaries. It is relieved by restoring the diseased structures to their normal condition. If produced by slightly adherent tubes and ovaries, benefit is often obtained by Churchill's tincture of iodine applied to the vault of the vagina, or externally applications of the same or of cantharidal collodion to the abdominal wall over the ovarian regions.

Douches once or twice daily of water as warm as can be borne, and continued for periods of two weeks, will also often relieve the dysmenorrhœa as a result of adherent lateral structures. These measures are, however, only, at the best, temporizing in character, and in rare instances they procure permanent beneficial results. To be absolutely certain that the dysmenorrhœa is dependent upon lateral diseases we must carefully examine these structures under anæsthesia.

Marked pathological conditions of the tubes and ovaries generally produce aggravated forms of dysmenorrhœa. The cure is to be found only in radical operative measures—*i. e.* removal of the diseased structures.

The internal administration of drugs for dysmenorrhœa produces in the vast majority of instances but palliative results. At times morphine in some form is necessary. Unfortunately, this measure is *too often and too quickly resorted to*, both by the general practitioner and the specialist. It is a most pernicious habit, and is to be strongly condemned. Patients soon learn to depend upon the anodyne, and before the attendant or patient is aware of it the morphine habit is established, and their condition soon becomes wretched indeed. Never administer

morphine except in the most urgent instances. If a patient presents herself suffering so acutely that morphine alone affords relief, immediately examine under anæsthesia, and if a lesion exists sufficient to produce pain, cautiously administer the drug from time to time until the cause is removed. This procedure, I am sure, will prevent many a neurasthenic becoming a victim to the use of morphine. I have seen a patient suffering with the most excruciating pains at her menstrual period due entirely to serious pelvic lesions. She had been treated for hysteria and other obscure troubles, and could only be relieved by the hypodermic use of large quantities of morphine. This plan of treatment was continued for many months. Examination under anæsthesia demonstrated a marked tubo-ovarian abscess on one side which had not been previously discovered. Relief followed the removal of a large pyosalpinx by abdominal section.

If drugs are employed, it is safer to rely upon external applications: a large turpentine stupe over the lower zone of the abdomen and across the small of the back for twenty minutes at a time, followed by hot moistened cloths or flaxseed poultices every half hour until relieved, and at times dry cupping across the back and lower zone of the abdomen, are of service. If an hysterical tendency exists, it is often of value to employ with the external applications of heat bromide of potassium or sodium, 10 to 20 grains, every two or three hours; also Hoffman's anodyne, 20 to 30 drops every hour for two or three hours in a drachm of cold water; tincture of capsicum, 1 to 2 drops in 1 drachm of warm water every half hour, to be repeated. All these measures can be adopted as a routine practice until the cause is removed.

MENORRHAGIA AND METRORRHAGIA.

Hæmorrhage from the uterus is a frequent symptom of a variety of uterine diseases. It is of the utmost importance that we should adopt a simple classification of the causes, and on this basis treat it from a practical and rational standpoint.

Hæmorrhage may occur at any period of a woman's existence from childhood to old age. Owing to its serious consequences if neglected, each case must be subjected to intelligent analysis and to active treatment.

I shall divide the causes into—

1. Extra-uterine, and 2. Intra-uterine.

I. Extra-uterine.

(*a*) Certain dyscrasias—as anæmia, etc.

(*b*) Plethora.
(*c*) Diseases of the heart and portal circulation.
(*d*) Tubal and ovarian inflammatory diseases—viz. hæmatosalpinx.

II. Intra-uterine.

(*a*) Recent laceration of the cervix uteri.
(*b*) Polypi.
(*c*) Myomatous tumors.
(*d*) Cancer of the uterus and cervix.
(*e*) Retroflexed, subinvoluted uterus.
(*f*) Abortion.

I. **Extra-uterine Causes.** (*a*) **Certain Dyscrasias—Anæmia, etc.**—Anæmia.—Menorrhagia or metrorrhagia in the anæmic seems to be due to lax fibre, and is best treated by a well-regulated hygienic régime. In advising exercise over-indulgence should be carefully avoided; short walks, however, or drives in the open air, or gymnastics with weights and dumb-bells, are beneficial. Massage and electricity applied to the lower abdominal walls, with well-regulated intestinal action and the internal administration of arsenic (Fowler's solution), quinine, and small doses of iron (Blaud's pills), 2 to 5 grains three times daily, almost always will meet with success.

(*b*) Plethora.—This is at times an obstinate cause of uterine hæmorrhage, generally most pronounced during the menstrual period, but it may continue for days between. Measures that prevent active blood- and tissue-formation are of service. The diet should be restricted. Salines are of value, such as Rochelle or Epsom salts, if the precaution is observed, however, not to produce any intestinal irritation. Bloodletting from the cervix with the spear-pointed or knife-bladed tenaculum (Figs. 86 and 87); numerous punctures should be

Fig. 86.

Fig. 87.

Spear-pointed and Knife-bladed Tenaculum, for depletion of the cervix.

made in the cervical lips, grasping the cervix with a tenaculum or bullet forceps, and then plunging the depleting instrument well into the tissues, allowing one or two ounces of blood to discharge. This local depletion relieves the plethoric systemic disturbance. It also will at times sufficiently relieve the uterine congestion to check the hæmorrhagic discharge. These depletory applications may be made two or three times monthly between the periods, guided by the effects pro-

duced. It is advisable, if an excessive flow occurs subsequent to puncturing, to apply tampons of absorbent cotton saturated with a 50 per cent. solution of boric acid and glycerin, to be removed after twenty-four hours.

(*c*) Diseases of the Heart and backing up of the Portal Circulation, and obstructions to the return of blood, such as may be caused by displacements of the uterus or thickened inflammatory bands or by tumors, act by producing a congested uterus, and uterine hæmorrhage results.

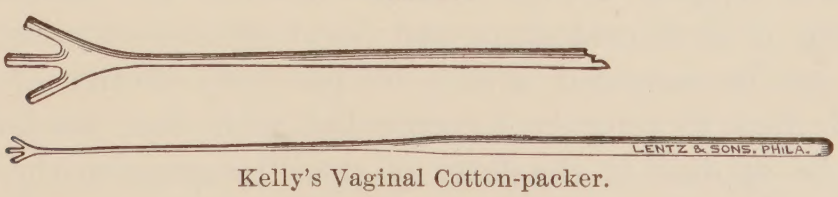
The therapeutics of such forms of menorrhagia or metrorrhagia must be directed primarily to the diseased organ. The heart may require such tonics as digitalis, strophanthus, nitro-glycerin, and various alcoholic stimulants. If due to portal obstruction, relief may only be expected by correcting the determining cause.

(*d*) Tubal and Ovarian Inflammatory Diseases.—viz. Hæmatosalpinx.—Uterine hæmorrhage occurring from any of these causes, singly or in combination, may often be cured by local applications to the uterine cavity, such as carbolic acid, 1 : 40 or 1 : 50, thoroughly swabbing out the uterus, or applications of nitrate of silver in strength of 1 : 40 or stronger.

Electricity has been used with much reported success in this form of uterine hæmorrhage, but, like local applications, it is of limited utility if the inflammatory lesions are marked, and under the worst circumstances a permanent result can only be obtained by the removal of the offending appendages.

II. **Intra-uterine Causes.**—(*a*) Recent Laceration of the Cervix Uteri is frequently the cause of a prolonged continuous bloody discharge. This should be treated either by immediately suturing the torn lips, or, if this is impracticable, by the local application of astringents. The use of powdered alum in the proportion of 1 or 2 drachms to a litre (1 quart) of hot water is often sufficient to control the hæmorrhage. If, however, this does not suffice, a tampon may be used of powdered alum or tannic acid, separately or in combination with equal parts of powdered boric acid. To apply this spread 2 or 3 drachms of the powder on a strip of iodoform gauze held on the palmar surface

Fig. 88.



Kelly's Vaginal Cotton-packer.

of the extended hand; with the packer (Fig. 88) place that portion of the gauze nearest the tips of the fingers beneath the posterior cer-

vical lip, the middle portion of the gauze containing the greater part of the powder immediately over the external os, and the remaining portion above the anterior cervical lip; this must be firmly and snugly placed in position. Externally to the gauze a tampon of absorbent cotton is placed. The gauze and cotton should not be allowed to remain in the vagina longer than twelve or twenty-four hours. After removal a douche of warm 1 per cent. aqueous carbolic solution should be given.

(*b*) Polypi.—These should be removed either with the écraseur, galvanic cautery, or by twisting them off with the polypus forceps. If the polypus is small, the bleeding may be temporarily checked by the application of Churchill's tincture of iodine to its site. Packing the uterus and vagina with iodoform and permanganate gauze will also stop the flow of blood. Internal hæmostatics are rarely of value, and are mentioned only to be condemned.

(*c*) Myomatous Tumors.—Hæmorrhage as a consequence of a myoma of the uterus is best controlled by the enucleation of the tumor. When submucous in character this may well be done with the écraseur or knife; when interstitial, the hæmorrhage can often be checked by a judicious curettement, as advised by some, followed by an application to the fundus of the uterus of Churchill's tincture of iodine or carbolic acid, 1 : 20 or 1 : 30.

The administration of fluid extract of hydrastis canadensis in 10-drop doses every three hours, increasing to every two hours, will often give relief. The oil of erigeron in 10-drop doses three or four times daily seems also in some instances to be of value in controlling hæmorrhage caused by myomatous growths of the uterus. I have seldom observed any beneficial results follow the administration of ergot; it is, however, highly endorsed by some authorities. The extirpation of the Fallopian tubes and ovaries will generally produce a permanent cessation of the hæmorrhage.

Hystero-myomectomy must be resorted to at times on account of the repeated hæmorrhages.

(*d*) Cancer of the Uterus and Cervix.—The necrotic areas should be thoroughly removed with the dull curette, or preferably with the finger-nail and finger, and Paquelin's cautery then deeply and carefully applied to the diseased cervical and uterine tissues. Applications of powdered alum and boric acid, equal parts; pledgets of cotton can be saturated with a 50 per cent. solution of boro-glycerin, and then thoroughly incorporated with the powdered alum. This can be applied in the form of small tampons to the cavity of the uterus and cervix, with a cotton-wool tampon against the external os. Powdered tannic and gallic acids are of value. If the hæmorrhage at any time should be suddenly profuse, it can be stopped by

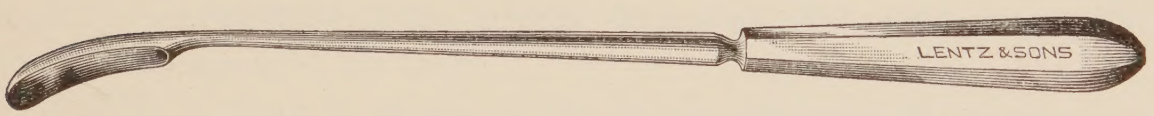
applying Monsel's solution on small cotton packs, filling the uterus and cervical canal, and additional pressure maintained by a vaginal tampon.

(*e*) Retroflexed Subinvoluted Uterus.—Hæmorrhage arising from a retroflexed subinvoluted uterus is treated primarily by correcting the malposition of the uterus. Before doing this, however, it is advisable to curette the uterus to relieve the engorged vessels; then tampons of absorbent cotton should be applied in the vaginal cul-de-sac, one on either side, and another immediately beneath the central portion of the posterior cervical lip to hold the uterus in position. In some cases a well-fitting pessary will be all that is necessary.

(*f*) Abortion.—Incomplete abortion is a frequent cause of hæmorrhage from the uterus. Remove the retained products if any exist. This can almost always be easily performed within the uterine cavity

Fig. 89.

Fig. 90.



Sharp Scoop Curettes.

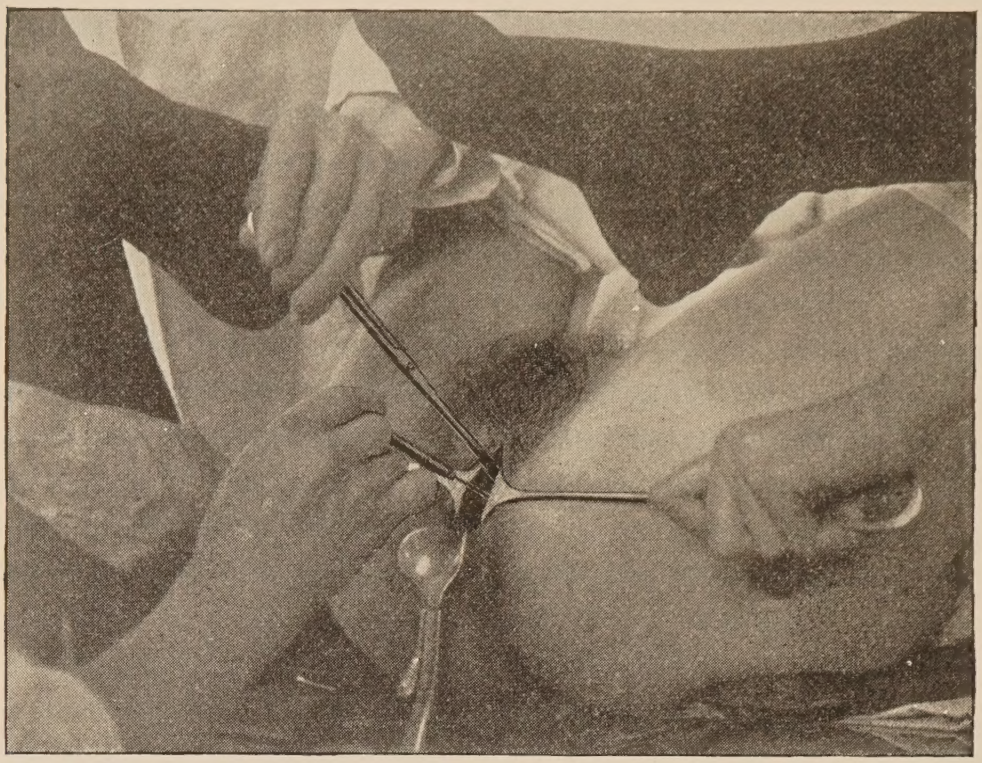
by the finger if the cervical canal is sufficiently dilated. If the cervix is not enough opened to allow of this, it should then be dilated as previously described, and the uterine cavity curetted with a sharp curette

Fig. 91.

Sharp Fenestrated Curette.

(Figs. 89, 90, 91 and 92). At times portions of the membrane can be felt by the examining finger, and twisted off by the finger or with the polypus forceps. After curetting the uterus subsequent to an incomplete abortion the application of a cotton tampon in the vaginal cul-de-sac may be sufficient to cause the organ to contract and stop the hæmorrhage. If the hæmorrhage continues, use vaginal injections of water, as hot as can be borne, 1 litre (1 quart), with 2 drachms of powdered alum added, every three or four hours. Hæmorrhage persisting after this would undoubtedly require the uterus to be curetted again, and this may be necessary even a third or fourth time, as the membranes

FIG. 92.



The Proper Method of holding Sharp Curette, like a pen gently poised in the fingers.

are often so tenacious that it is impossible to remove them all at one sitting; I have met with such cases in early abortion.

STERILITY.

STERILITY is a condition in which a healthy spermatozoön fails to reach and fertilize a healthy ovum. The term "sterility" naturally only applies to a man or woman in the child-begetting period of life—approximately from eighteen to forty years of age for the female.

Conception is impossible and sterility *absolute* under the following circumstances:

1. Where the male produces no living zoösperms;
2. Where the female produces no ova;
3. Where there is atresia of the female genital tract;
4. Where practices of the couple interfere with conception, as in onanism (not masturbation) and the use of the condom.
5. Sterility is not absolute, but probable or relative, in cases of incomplete coitus, as in case of deficient erection and penetration of the male; or,
6. Where impediments exist to the congress of spermatozoön and ovum—*e. g.*,

(*a*) After removal of uterus and Fallopian tubes, leaving a small fistulous tract in the abdominal cavity;

(*b*) Tumors of the uterus (myomata);

(*c*) Cancer of the uterus;

(*d*) Various diseases of the Fallopian tubes;

(*e*) Diseases of the ovaries.

1. Where the male produces no living zoösperms: Microscopic examination of the ejaculated fluid should be made to determine positively this condition. The treatment is stimulatory, as by steel sounds slowly introduced through the urethra every two to three days, gradually increasing the size of the sound. Kneading the testicles and epididymis, the local use of tincture of iodine to the scrotum, and electricity may increase the nutritive function of the seminal tubule sufficiently to produce living zoösperms.

2. Where the female produces no ova: Most of these cases are utterly hopeless; all measures should be adopted to improve the general health. Hygienic regulations must be systematically carried out —baths, well-regulated exercise, suitable foods, and massage of the abdominal walls, particularly of the lower abdominal zone, three or four times weekly, according to tolerance. These methods of treatment all tend to quicken the circulation and to stimulate healthy function of all organs of the body.

3. Where there is atresia of the female genitals: Many cases are hopeless. Where a small septum separates healthy organs dilatation should be resorted to; this is more satisfactorily performed under anæsthesia. When the parts are entirely closed it will be necessary to create a new canal; if they are but partially closed, dilatation may be performed by the examining finger well coated with vaseline, or with Hegar's dilators, beginning with the small sizes, or by means of the larger-sized corrugated Ellinger's dilators.

4. Where practices of the married couple interfere with conception, onanism (not masturbation), the use of the condom: These practices are unquestionably a most fruitful source of sterility in a large percentage of cases. Medicated douches immediately following intercourse, sponges inserted in the vagina and withdrawal, play an important part in this category. The treatment is the cessation of the practice.

5. Incomplete coitus, as deficient erection and penetration by the male: Sterility is a consequence in many instances of the above cause. We must therefore ever bear this in mind in treating any case. There are instances on record where the wife has been treated for a long period of time, and the cause altogether the fault of the husband, who should receive the treatment.

6. Where impediments exist to the congress of spermatozoön and ovum: Removal of the uterus and Fallopian tubes, leaving a small

fistulous tract in the abdominal cavity. But a single case is on record, and it is of course manifestly impossible for such an extra-uterine pregnancy to advance to a natural termination.

7. Cancer of the cervix and uterus: But few cases of cancer of the cervix and uterus become pregnant. Sterility here does not call for treatment.

Submucous myomata may be removed with the écraseur or by splitting the capsule of the tumor and thus removing the growth. Subperitoneal myomata, and interstitial myomata should be removed by cœliotomy. In some cases interstitial myomata may occupy a portion of the uterus close to the internal mucosa: they may be sufficiently removed by curetting the cavity of the uterus, and permit pregnancy to occur and successfully terminate.

Salpingitis and **Ovaritis** are frequently the cause of sterility. Local applications to the vaginal fornices of Churchill's tincture of iodine, followed with a 50 per cent. boro-glycerin tampon of cotton two or three times weekly, in combination with douches of hot water, 1 litre, at a temperature of 112° F. every day, is of value in mild cases.

If there are many adhesions, dense in character, they should be separated by abdominal section or by removal of the diseased structure.

DISEASES OF THE BROAD LIGAMENTS, TUBES, AND OVARIES.

By HOWARD A. KELLY, M. D.

GENERAL METHODS OF TREATMENT IN INTRA-PELVIC DISEASES.

By Drugs.—Owing to the peculiar anatomical position of the Fallopian tubes and the ovaries, these organs cannot be treated directly by topical applications, as we are enabled, for example, to treat diseases of the tonsils or of the cervix uteri. Nor can we even hope for such a diluted action of drugs on the ovaries and tubes as we obtain from ingested medicines upon the intestinal tract. The only possible way of treating these remote organs medicinally is by the agency of drugs which, in order to reach the disease, must first be absorbed, taken into the general circulation, and thus equally applied to every other organ and tissue in the whole body.

The hope which has ever been cherished by the profession, that we might at some time come into possession of a drug or drugs exercising special selective curative action upon affections of the tubes and ovaries, more especially the latter, has proven illusory, if not unreasonable, for we possess no such medicine.

The argument is little improved by citing a supposed specific action of such a drug as ergot upon the uterus; for we well know that no such specific action exists, as the influence of ergot is not strictly localized in the pelvis, but is felt as well in all parts of the body, affecting all the unstriated muscular tissue. We must also acknowledge, with regret, how little benefit has accrued to uterine pathology from the use of ergot. It is therefore highly improbable that any drug will ever be discovered which acts selectively upon any single morbid pelvic condition.

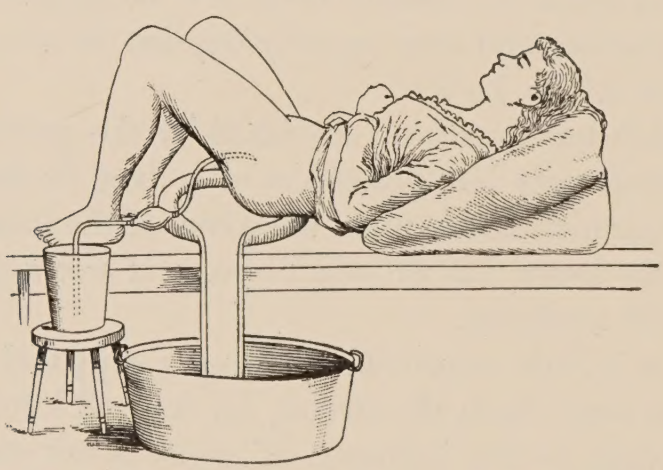
Contrary to these conclusions of the writer, the gynæcological literature of this country abounds in positive statements, with citations of cases, intended to exhibit the specific virtues of a long list, more especially of our native drugs. It is certain, however, that the powers of these drugs have thus far eluded the analytical grasp of the scientific gynæcologist; it is, moreover, a significant fact that many of the

drugs seem to yield their virtues most readily in the form of a proprietary compound whose composition always contains an *x* quantity, and *x* has, unfortunately, too often been found in similar preparations to be equal to morphine, cannabis indica, or other noxious sedatives. The rational medicinal treatment of these affections is therefore purely symptomatic and palliative.

Pain in Pelvic Diseases.—The abundant supply of nerves distributed to the uterus, ovaries, and tubes, and the large nerve-trunks in the broad ligaments, afford a ready explanation of the very frequent association of pain with pelvic diseases of all sorts—pain due to inflammation, acute and throbbing, associated with much local tenderness and marked elevation of temperature, and the pain and tenderness left behind by old attacks of inflammation holding ovaries, tubes, and uterus abnormally fixed and misplaced, or pain associated with congestion, acute or chronic, in such abnormal organs.

Such pain should be combated in its exacerbations by absolute rest in bed and hot vaginal douches (temperature 112°–120° F.), given not by the patient herself, but by a nurse, for from fifteen to twenty minutes at a time and at intervals of two or three hours. The way in which the injection is given is of importance. For this purpose the ordinary syringe with a bulb squeezed by the hand is better than the

FIG. 93.

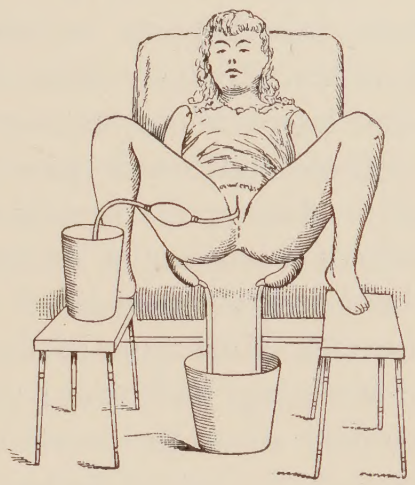


Giving a Vaginal Douche with the Patient lying in the Ordinary Position in Bed, the hips resting on Kelly's obstetric or general surgical cushion, which drains all the water at once into the vessel at the side of the bed.

fountain syringe, as the intermitting force of the jet of water is effective. The douche can be given with least discomfort to the patient by placing her upon the author's obstetric cushion, provided with a high rim, and conducting the apron of the cushion over the side of the bed into a bucket (Fig. 93). If the mattress is soft and the cushion sags too much in the middle, a lapboard should be slipped under the sheet. In this way it is not necessary to bring the patient across the bed, resting the feet on chairs. It also avoids the frequent changing

necessary when a bed-pan is used. When the inflammation is not acute, the patient may be brought to the edge of the bed on a perineal cushion or a rubber sheet arranged to direct all the water down into the waste-bucket, and with the feet resting on stools the douche can be very comfortably given (Fig. 94). Excellent utensils have also been constructed for this purpose, one of the best of which is Cleveland's bed-pan, a japanned tin vessel like a milk-pan, with a broad rim extending inward; upon this the patient sits during the douching, and the water runs into the pan and is continuously conducted out into a vessel by the side of the bed through a large rubber hose attached to an opening in the side.

FIG. 94.



The Patient brought to the Edge of the Bed, the feet resting on stools and the buttocks on Kelly's perineal cushion, which drains all fluids used at once into the bucket.

Hot hops or bran poultices, a mustard poultice (mustard and flour), hot fomentations sprinkled with turpentine, a hot poultice of lead-water and laudanum large enough to cover the lower half of the abdomen or at least one of its lower quadrants, continually renewed and kept up from half an hour to one hour, and repeated later, are among our domestic remedies, and still among our most valuable adjuvants in dealing with severe pelvic pain. An iodoform suppository (3 grains) or a belladonna suppository ($\frac{1}{2}$–1 grain) by the rectum often gives material relief when the suffering is not too acute.

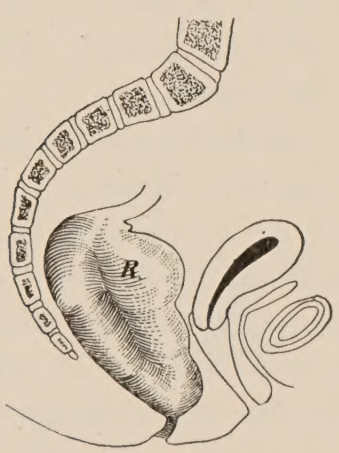
Following or associated with these local remedies the milder sedatives are valuable, such as bromide of sodium or potassium, in repeated small doses (5 grains) through the day or in a single larger dose (20 to 30 grains) at night. Chloral is a particularly valuable sedative; it is most effective given in a mucilaginous enema (20 to 40 grains) alone, or, better, combined with bromide. Morphine and opium are to be avoided, except as last resources, on account of masking the true symptoms and locking up the emunctories, as well as the disagreeable after-effect, added to the frightful danger of inculcating a habit to which neurotic women are peculiarly prone, and from which escape is almost impossible. In acute exacerbations of pain, however, the necessity is sometimes great enough to compel their use. Morphine is most effective when given hypodermically ($\frac{1}{8}$ to $\frac{1}{2}$ grain) by the physician, always, if possible, keeping the patient in ignorance of the means being employed for her relief. Opium is best given by the rectum, either as a suppository (1 grain of the aqueous extract) or 15 to 40 minims of the deodorized tincture in starch enema, or the

officinal lead-water and laudanum (1 ounce). It is a cardinal rule that opiates should never be used in any form except under the direct and constant supervision of the physician.

Cannabis indica ($\frac{1}{4}$ to $\frac{1}{2}$ grain of the extract), repeated every half hour, acts happily on some patients, while upon others it seems to have no effect—a want of reliability which, seemingly due to inefficient preparations, makes the drug very unsatisfactory.

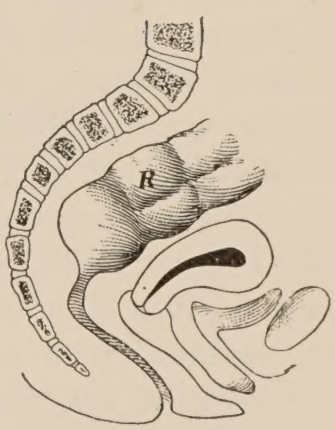
Constipation is peculiarly prone to occur in almost all cases of pelvic disease, for several obvious reasons : in the first place, the presence of a mass or of an inflammatory exudate in the contracted bony channel of the true pelvis mechanically interferes with the pressure of the abdominal muscles during the act of defecation, rendering the act of straining inefficient; also the presence of a hard, inflexible ring of exudate across the rectum would seem to cut short a peristaltic wave, so that the act of defecation is often imperfectly accomplished, and only a small amount of fæcal matter is expelled with great exertion. Again, the amount of pain attendant upon the act of defecation, due to the displacement of the pelvic floor and the associated dragging upon the diseased structures, often causes women to defer these calls of nature indefinitely. This in time brings about a blunted sensibility to the fæcal accumulation above or below, or both above and below, the point of stricture or diminished calibre of the bowel around and behind the uterus.

FIG. 95.



Showing the Rectal Ampulla distended with Fæces and crowding the Uterus forward.

FIG. 96.



Showing the Rectum loaded with Fæcal Masses above the Utero-sacral Ligaments.

One of the prime duties of the physician is to see that this fæcal stasis is relieved, and to continue keeping watch over the patient afterward to prevent its recurrence. Never rest satisfied with simply securing a reply from the patient to the effect that there has been a daily movement from the bowels. Such a motion may be nothing more than the slight overflow from an excessive accumulation. In these cases examination through the posterior vaginal wall will at once

reveal the cylindrical more or less impressible mass occupying the lower extremity of the bowel. The loaded upper bowel may also often be felt through the vault of the vagina, or, still better, by careful abdominal palpation.

A brisk saline purge by the mouth, followed as soon as the desire for a movement is felt by a rectal enema (castile soap enough to make milky, sweet oil 2 to 4 ounces, and warm water enough to make a pint), will soften down the mass and unload the lower bowel, greatly relieving the patient. Sometimes repeated enemata or an enema of a half gallon is necessary to clear the large bowel of its accumulated load. Daily movements should be secured after this by regulating the diet, encouraging the patient to partake of vegetables, oatmeal in the morning, brown bread, one or two figs after dinner, and stewed prunes in the evening. An apple after dinner helps some, a glass of extract of malt relieves others. A glass of cold water taken slowly upon rising from bed is a valuable adjuvant in securing an action at the best time of the day—after breakfast. A daily glass of Congress and Vichy waters has proven invaluable in many cases; to this may be added a tea-spoonful of Carlsbad salts, which also act well taken in hot water. The stronger waters, Friederichshalle, Hunyadí, and Racozzi, are often efficient adjuvants.

The daily use of aloin pills, alone or in various combinations, is to be deprecated. The best use of these drugs is when employed at intervals of three or four days, using other means between times.

No treatment makes up for the absence of healthful exercise, which should never be forgotten.

Massage.—The employment of massage for diseases even as remote from the surface of the body as those of the ovaries and tubes has of late come extensively into vogue, having found many enthusiastic adherents. If the word "massage" be used in its more general sense, to signify any sort of manipulation by which a displacement is corrected or an adherent organ released from its abnormal attachments, then massage is of service in certain diseases of the ovaries.

The writer has repeatedly observed since he first began to treat cases of pyosalpinx and hydrosalpinx that by combined pressure through the abdominal wall and the vagina some of the fluid contents of the tumor could frequently be forced down through the uterus into the vagina, where it would appear at the outlet. This is most evident in the course of an abdominal section when the tumor is grasped in the full hand or squeezed with the fingers in enucleating; the pus then literally gushes through the uterus and vagina. Such pressure, methodically made at regular intervals through the abdominal walls, with the distinct aim in view of emptying the tubes into the vagina by way of the uterus, constitutes the treatment of these diseases by massage. Massage is there-

fore not one of the general therapeutic measures. Its employment must be strictly limited to certain definite forms of disease, under which it will be discussed.

The great danger in this form of treatment must ever lie for the general practitioner in the difficulties in the way of his forming an accurate diagnosis of the particular form of disease under consideration, excluding the presence of encysted collections of pus. In the case of pelvic inflammatory masses such treatment must always be undertaken tentatively, with extreme precautions as to gentleness and with constant observation of the patient's condition: if fluid can be thus forced through the uterus, the sittings should be repeated until the sac remains permanently empty.

Electricity is often spoken of as valuable in minor pelvic complaints, but it has never won for itself any such well-defined field as has been claimed for it in the treatment of uterine fibroids. I do not know that it is now proposed by means of this agent to cure any particular form of tubal or ovarian disease. The claim made that electricity is of use in relieving "tenderness lateral to the uterus" or "ovaralgia" is too general to be of service, for neither of these expressions points to any well-recognized disease.

DISEASES OF THE BROAD LIGAMENTS.

Primary affections of the broad ligaments, or affections limited exclusively to the broad ligaments, are rare. In this statement is involved the characteristic difference between the more scientific gynæcology of to-day and the gynæcology of thirty years ago.

In the gynæcology of our predecessors, and indeed in some eminent works issued within the last decade, *parametritis*, or inflammation of the cellular tissue lying at the base of and between the broad ligaments, therefore called also *pelvic cellulitis*, occupied the most important position in the schedule of gynæcological affections; its inflammations and their termination either in resolution or suppuration were elaborately described and the treatment carefully detailed. The gynæcologists of to-day ask for evidence in the dead-house that such disease exists except as a great rarity, and no such evidence is forthcoming. We therefore drop the term "parametritis" from our vocabulary, insisting that our predecessors confused under this title the common tubal and ovarian diseases accompanied by inflammation of the pelvic peritoneum, pelvic peritonitis, with fixation by adhesion of opposite peritoneal surfaces, and often terminating in suppuration, which dis-

charges by election into the rectum or vagina, more rarely into the peritoneal cavity or bladder.

With this change in the relative importance of parametritis the diseases of the broad ligaments drop very low in the ranks of relative importance in pelvic pathology. The only instances in which the bases of the broad ligaments do become inflamed are where septic matter is directly transmitted by a wounded cervix, as in sepsis following delivery.

The treatment directed by our predecessors against parametritis is the palliative treatment of inflammatory diseases involving the tubes and the ovaries.

Diseases which are peculiar to the broad ligaments are those of the round ligaments: these are *hydrocele,* which is intraperitoneal, corresponding to the hydrocele of the canal of Nuck, and *fibroid tumors.*

Fibroid tumors are found as well in other parts of the broad ligament, when they develop from the lateral wall of the uterus, at the same time pushing the uterus in the opposite direction. The tumor also enfolds the broad ligament, widely separating the anterior and posterior layers, as it develops upward into the abdominal cavity and downward on to the pelvic floor. The treatment of such fibroid tumors, when sufficiently large to occasion pressure and symptoms warranting removal, is by enucleation. The abdomen is opened, the tumor exposed, and the capsule of the broad ligament split open: one or two fingers are carried through the opening, and the cellular tissues on all sides are stripped off from their connection with the tumor. The enucleation is in this way sometimes easily completed. Again, considerable difficulty and danger arises from the presence of large veins in the broad ligament; these are liable to be wounded or torn in shelling out the tumor. Bleeding walls must be freely clamped and tied. After the simple enucleation of such a tumor all bleeding must be completely checked, when the peritoneal surfaces are brought again into apposition and the abdominal wound is completely closed.

A fatty tumor of large size has been discovered in the broad ligament. It is impossible to make such a diagnosis before operation, which must of necessity begin as an exploratory incision.

The treatment of papillary and parovarian tumors will be described under Ovarian Diseases.

ASSOCIATED INFLAMMATORY OVARIAN DISEASE AND TUBAL DISEASE.

THE proximity of the tubes and ovaries and their intimate functional association are the occasion also of their constant association in many important diseases. Inflammation involving one almost as surely involves to a greater or lesser extent the other organ. Such common inflammatory diseases are perioöphoritis and perisalpingitis and tubo-ovarian abscesses. Perioöphoritis associated with perisalpingitis is a disease characterized by adhesions binding ovaries and tubes together, occluding the fimbriated extremity of the tube, and binding both structures down to the pelvic walls, the pelvic floor, and the posterior surface of the broad ligament. The treatment of such diseases resolves itself into the treatment of an acute attack, and treatment of the chronic form after the acute attack has subsided. During the acute attack, characterized by pain, sometimes by moderate elevation of temperature, and by much local tenderness, repeated hot-water injections, using water as hot as it can be borne (112°–120° F.), given every one or two hours, with absolute rest in bed and free saline purgation, avoiding the use of opiates, will all be of great service. After the severity of the symptoms has passed off and the patient is able to be on her feet again, packs of boroglyceride on absorbent cotton, applied three times weekly, with occasional bloodletting from the cervix, from four drachms to an ounce, with a fly blister over the lower abdomen for any persistent pain, will often make the patient comfortable. In addition, where the case remains for a long period under observation, tonic treatment, baths, change of air, are most valuable adjuvants in restoring health.

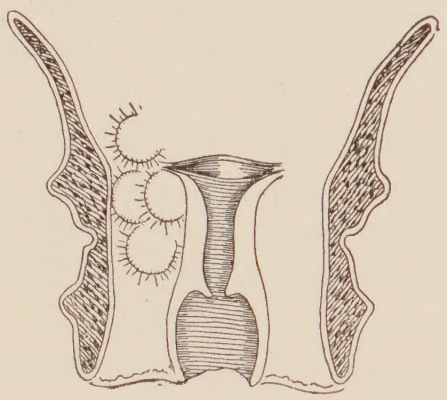
In the chronic condition, where the patient continues to suffer with pains greatly aggravated at the menstrual period, menstruation is disordered, and she is by her sufferings rendered wholly unfit for the ordinary duties of life, it will be necessary, after a faithful trial of milder means, to attack the disease when non-purulent under an anæsthetic, either by separating the adhesions, stripping up the ovary and tube, or by abdominal section and separating the adhesions, or, if the structures are found so intensely diseased as to be useless, removal will be indicated.

I would here expressly warn against any meddlesome treatment where the attendant is not absolutely sure of the nature of the affection. The simple inflammatory diseases are too easily confounded with the remains of a tubal or an old ovarian abscess which may still contain pus, and rupture in the manipulation, and escape into the abdominal cavity, possibly occasioning death. The operation of enucleation and removal of such masses is described in the treatment of ovaritis and salpingitis.

PERIOÖPHORITIS AND PERISALPINGITIS.

PERIOÖPHORITIS associated with perisalpingitis is peculiarly a disease of the pelvic peritoneum, and when it affects the tubes and the ovaries does not involve more than their peritoneal covering. The result of such inflammation is adhesion between tube and ovary, the pelvic floor, pelvic walls, and the posterior surface of the broad ligament. The tube has a peculiar habit of dropping over the back of the broad ligament and down toward the floor; while the ovary may adhere *in sitû* by its under surface or low down on the pelvic floor, or even high up against the pelvic wall at or near the superior strait (Fig. 97). It is often this disease which arises during the menstrual period, occasioning severe local pain with marked tenderness, causing the patient to rest or even go to bed for a few days. It is particularly prone to be confused with ovaralgia, menstrual catarrh, etc.

FIG. 97.



Different Sites for an Adherent Ovary: at the cornu uteri, down on the pelvic floor, out on the pelvic wall, and up near the brim of the pelvis. Coronal section.

Diseases of this kind, beginning in early life, develop all the neurotic tendencies of many women: they become spare and worn, and the repeatedly-excited nerves are always ready for an outbreak. These constitute a class of sufferers who are apt to be greatly misjudged by friends and physician, who do not recognize the distinct physical basis of the trouble.

Treatment consists in rest during the attack, the use of the hot-water douche after the menstrual period has passed, of gently-applied supporting packs against the vault of the vagina, medicated with glycerin or boroglyceride, 2 or 3 drachms. The patient is sometimes much relieved by a fly blister an inch square on the lower part of the abdomen over the ovarian region. Sedatives should be given to a limited extent during the acute period of the attack: the best are cannabis indica, bromide of potassium, camphor, hyoscyamus, and Dover's powder, in small doses repeated. In the intervals the hygienic state of the pateint should be carefully investigated, and her bodily functions regulated, nourishing diet ordered, and systematic exercise prescribed.

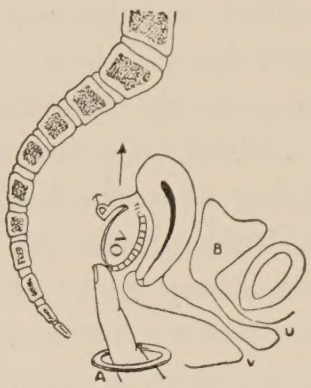
BREAKING UP THE ADHESIONS.—If the sufferings persist in spite of such treatment the patient should be placed under anæsthesia, and the uterus brought down toward the vaginal outlet by means of the author's corrugated tenaculum hooked into the cervix (Fig. 98), while a bimanual examination is conducted *per rectum* and *per abdomen*: the ovaries and

sometimes the tubes will then be distinctly felt to be adherent. This is evident from the fact that every movement communicated to an ovary

FIG. 98.

Palpating an Ovary adherent to the Broad Ligament by bringing the uterus down and holding it with a corrugated tenaculum while the index finger examines *per rectum*.

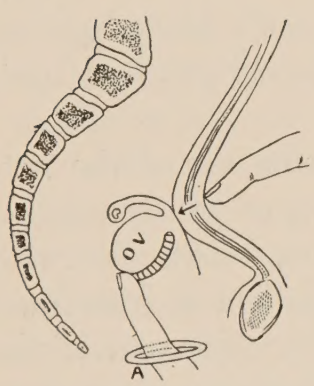
FIG. 99.



Direction in which to Push to break up Adhesions binding Ovary down.

moves also the adjacent part of the broad ligament, and the ovary has no free motion of its own. The tube when thus adherent often becomes distended with clear watery fluid, whence the name "hydrosalpinx."

FIG. 100.



Palpating an Adherent Ovary bimanually.

Bearing in mind that the ovary is adherent by its under surface to the posterior surface of the broad ligament, the examining finger will at once easily be able to peel it up from its bed of adhesions by reversing the direction in which it has become displaced by pressing upon its lower border with the pulp of the index finger, and pushing it up until it yields slightly, when the finger is insinuated between the under surface and broad ligament and the border of the ovary, and with the better leverage the ovary is further stripped all the way up to its hilum and thus freed from all adhesions. The counter-resistance afforded by the abdominal hand throughout is an important adjuvant to the successful performance of this small but delicate operation. The adhesions thus broken can be distinctly felt cracking under the fingers, and the sound as they rupture is at times even audible to a bystander. After such an operation rest in bed is important for at least a week, the bowels should be kept open, and on the signs of slightest inflammation an ice-bag kept on the lower part of the abdomen.

OVARITIS AND SALPINGITIS.

Acute Inflammation of the tube and ovary is always a result of septic infection proceeding up the tube and finding in its mucosa and in the stroma of the ovary a suitable nidus for development. During the acute stage treatment consists in absolute rest, hot douches, ice poultices to the lower abdomen, with diuretics and opiates to relieve pain and quiet intestinal movements.

The thickened tube and the inflamed ovary may recover so as to leave no trace of the disease. Where the process has been more intense and protracted the most favorable recovery is a hard, contracted, withered tube and a small dense ovary—both functionally valueless. This condition is persistent.

The treatment of this condition resolves itself not into the treatment of a deformity or a formidable disease, but of the discomfort attendant or dependent upon the condition. These discomforts consist in pain at or between the menstrual periods. Until every effort has been made to relieve this pain by simpler measures surgical interference is unwarrantable.

Among the most important measures of relief are the hygienic, such as exercise, change of air, nutritious diet, massage, regulation of the emunctories, combined with such simple medicinal remedies as are adapted to the varying requirements of the case, absolutely avoiding all drugs obnoxious to the stomach. Occasional doses of the sedatives will be required—asafœtida, camphor, henbane, cannabis indica, or sodium bromide in the compound infusion of gentian. Electricity in the form of galvanism should receive a faithful trial. Massage, gently handling the diseased organs and gradually extending the old contracted bands binding them down and shortening the pelvic peritoneum, will sometimes effect relief from the pain. These are palliative measures which may carry the patient along with considerable comfort for many years, when with the menopause—which, however, is often delayed—comes a period of more complete relief.

In the working class the indication for treatment is more positively in one direction. Women of this class cannot afford the luxuries of rest, comfort, and pleasure seeking: they are too often obliged to work in spite of the utmost distress. When, therefore, they give up it is apt to be definitely for radical treatment. The only radical remedy is the exsection of the diseased structures, called salpingectomy and oöphorectomy.

If the operation of cœliotomy (abdominal section) were a panacea for the sufferings of patients of this class, it would then find in the writer not only an advocate, but an enthusiast urging it upon the profession. I state the matter in this way because it is often tacitly

assumed that abdominal section, with removal of the diseased organs, is beyond peradventure curative. This, however, is not the case, and the most bitter enemies of surgeons, often those who have spared no efforts to restore their patients to health, are those who go about stating that "in spite of the fact that I was assured that this operation would cure me, I still suffer." The liability to error lies in fact that the *pain* is ever before the patient as the one thing which makes life miserable: the morbid changes discovered by a bimanual examination are apt, on the other hand, to be paramount in the mind of the doctor. Removing all tangible disease does not always relieve the aches. Never promise "cure;" there are too many chances of failure. A completed operation may be impossible, owing to the density of bowel adhesions; it may prove impossible to get the structures up out of a dense bed of adhesions; old deposits containing pus may be unexpectedly opened, increasing the dangers; a certain percentage of cases die from septic peritonitis or ileus, followed by invasion of the peritoneum by the colon bacillus; cases which recover promptly from the operation may even continue to suffer just as before; and under the most favorable circumstances the patient goes through a prolonged convalescence, and if she makes a perfect recovery she is usually a year in reaching full health. Place yourself frankly and honestly at the very start on a right footing with the patient: state the difficulties and the dangers and the possibility of a slow recovery, but never promise a "speedy cure."

When the operation is elected, it must be decided upon because other means have failed to give relief and the symptoms are of sufficient gravity to demand operative interference. Be satisfied with the operation if it materially diminishes suffering, making a life before unbearable now endurable. Look upon the operation as but a step—a big step and a necessary one, but still only a step—in the stairway leading to health: teach the patient to look on it as such, and she will be content to take the steps which come after, still under your guidance. It is the great error of our gynæcology to-day to look upon the operation as the central point in comparison with which all else falls into the shade and to which everything else acts but as the setting.

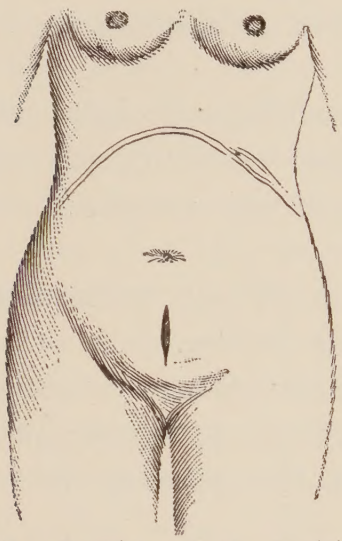
Enucleation of chronically inflamed tubes and ovaries is effected by the following steps, which I shall briefly detail without entering minutely into the technique:

1. Incision about 7 or 8 cm. (three inches) long in the median line of the abdomen, starting about an inch above the symphysis (cœliotomy).

2. Carrying the index and middle fingers within the abdomen and down toward the symphysis pubis, over the top of the bladder into the

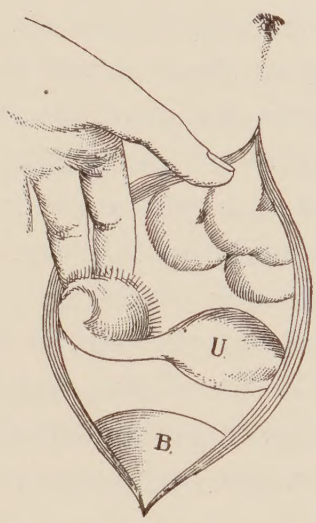
pelvis, where they are at once engaged in palpating the pelvic structures, estimating probable difficulties in the way of the operation.

Fig. 101.



Showing the Position of the Incision just above the Symphysis Pubis.

Fig. 102.

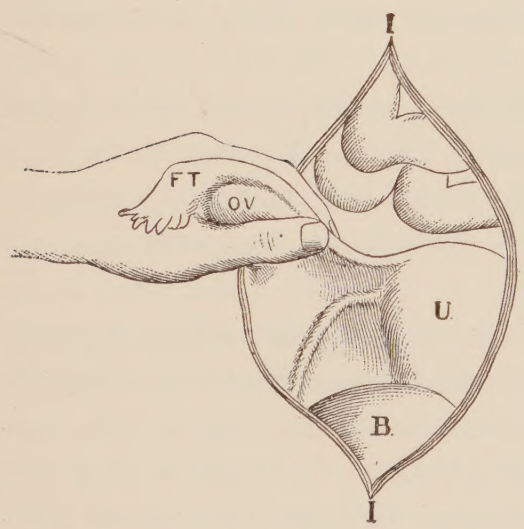


Digging out an Ovary imbedded in Adhesions, by working the fingers in beneath and shelling it out or rolling it upward.

3. Releasing pelvic omental adhesions.

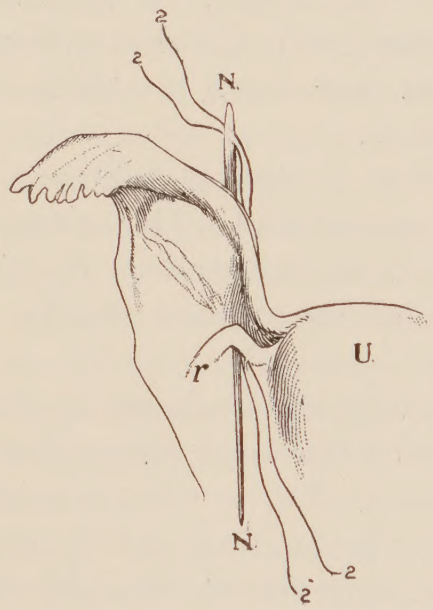
4. Gently releasing all adhesions of the small intestines, when dense under guidance of the eye.

Fig. 103.



Bringing the Tube (FT) and Ovary (OV) out of the Abdominal Incision (I, I), for the purpose of transfixion, tying off, and removal. They are thus grasped at their "anatomical neck," the isthmus of the tube and the utero-ovarian ligament, between thumb and forefinger. U, uterus; *r*, round ligament; B, bladder.

Fig. 104.



Transfixion of Elevated Tube and Ovary, the needle (N, N) being passed below the round ligament (*r*), carrying ligatures (2, 2), which are tied in both directions, toward uterus (U) and pelvic wall.

5. Peeling the ovary and tube out of their adhesions to the pelvic wall, pelvic floor, uterus, and posterior surface of the broad ligament,

unwrapping an ovary and tube which have dropped down on to the pelvic floor by rolling them upward in a reverse direction.

6. Persistent traction efforts toward the median line, applied intermittingly to the ovary and tube, grasped between the index and middle fingers or between the thumb and index and middle fingers, resulting in bringing them out of the incision.

7. Transfixion of the broad ligament (pedicle) well down below the tube and ovary (sometimes under the round ligament), and tying the ligatures and cutting away the diseased structures about a third of an inch beyond the ligature.

8. Careful cleansing of the peritoneum of any accumulation of blood behind the uterus by a sponge on a holder.

9. Closure of the abdominal wound by two rows of sutures: *a*, a continuous catgut suture closing the peritoneum; *b*, sutures (preferably silkworm gut) bringing together the fasciæ, the muscles, the subcutaneous tissue, and the skin.

Either at once or gradually the pain disappears, and the individual has now a trying year to pass through the neuroses of an artificially induced menopause in case both ovaries and tubes have been removed. Throughout this time she is in constant need of medical supervision.

Tubo-ovarian Abscess.—It is but a step from the acute inflammatory to the suppurative stage. They are hence but different stadia of the same disease. I speak here upon the broader, more superficial, and purely clinical basis, without reference to the distinctive forms of bacteria and cocci to which these diseases owe their true specific characters.

When an abscess has once formed, the patient must be watched with especial care. Her strength must be kept up by nutritious food and a moderate amount of stimulants, strict rest enjoined, and the course of the abscess closely watched by touch, temperature, and pulse.

Nature, who is always instructive, has two ways of curing a pelvic abscess of this sort: either, first, by encapsulation, effectively shutting the poison off from the peritoneum and surrounding organs; or, second, by perforation and evacuation down into the vagina, into the rectum, into the bladder, into the bowel, or into the peritoneal cavity. The last mode is fortunately rare. It can only be called curative in the sense that it relieves the abscess of its contents, for the result to the patient is often death. Natural evacuation by any other inferior channel than the vagina is apt to be unsatisfactory, not completely emptying the abscess, creating an intermittent discharge of pus, and in the case of the bladder sometimes causing violent, even fatal, inflammation from involvement of the ureters and kidneys.

Nature in these efforts points out the way. The vagina is the most

favorable point for the rupture of an abscess; we should therefore seek to determine the discharge at this point by opening the abscess when it points here in the vault of the vagina, just behind the uterus, a little to the right or the left of the median line. Nothing is simpler in suitable cases, nothing is more dangerous in unsuitable cases or if bunglingly done. In the first place, there must exist either a distinct area of softening and fluctuation, or, in the second place, the large abscess-sac with its uniform hard walls must choke one side of the pelvis and depress the vaginal vault, so that the instrument making the opening shall not traverse any portion of the free peritoneal sac. A clumsy incision with a knife widely to the right or to the left of the cervix may easily wound one of the ureters. To perform the operation, thoroughly cleanse the vagina with the patient on her back, with well-flexed thighs resting on the author's perineal cushion; then introduce a pair of long sharp-pointed scissors up to the vaginal vault, guarded by the index finger; the outside hand then grasps the handle and unswervingly thrusts the point up into the most prominent part of the sac from two-thirds to one inch; the handles are then separated, also separating the blades, and the incision is torn widely open as the blades are withdrawn. Pus flows at once freely into the vagina, and the wide opening ensures a constant free discharge. The index finger is now pushed up into the sac and its interior gently palpated. If any septa dividing off other abscess-cavities are felt, these must be cautiously broken through and their contents evacuated. Such additional cysts will best be discovered with the assistance of the abdominal hand. Care must be taken not to make pressure on the sac-wall on the side of the abdominal cavity, to avoid the risk of perforation.

It must also never be forgotten that even after evacuation by the vagina perforation into the peritoneum may occur; the removal of the tension, the collapse of the cyst-walls, with the consequent stasis in the local circulation followed by necrosis, are clearly predisposing causes to this unusual accident. In event of such an occurrence abdominal section must be performed immediately, the peritoneal cavity washed out, and the abscess-sac enucleated from above.

In the majority of instances, particularly in old cases, the disease will best be removed by enucleating the diseased structures through an abdominal incision—laparotomy for tubo-ovarian abscess.

Before undertaking to open the abdominal cavity above the symphysis pubis to remove a tubo-ovarian abscess the operator must have had such previous special training as will fit him to meet any of the various emergencies which are liable to arise: he must be prepared to deal with extensive omental and bowel adhesions, with dense adhesions to the intestines which will tear open its lumen upon separation, with free hæmorrhage from deep pelvic adhesions, with tears in the broad

ligaments, etc. etc. For the general practitioner or the general surgeon to perform an occasional operation of this sort is an unwarrantable trifling with life. Many lives have been sacrificed upon the altar of such egotism.

The steps of this operation are briefly these:

1. An abdominal incision 6–8 cm. ($2\frac{1}{2}$–$3\frac{1}{4}$ in.) in length.

2. Carrying in the fingers and palpating the pelvic organs. The pelvis seems choked with ill-defined nodular masses. By this step we make a preliminary study of the field of operation.

3. Separation—*a*, of omental adhesions, freely sacrificing the omentum when necessary; *b*, careful separation of intestinal adhesions, sacrificing the cyst-wall when necessary to the advantage of the intestine: this must be done by both sight and touch, by securing a free field by packing away the non-adherent intestines with sponges and widening out the incision by retractors.

4. The enucleation of the diseased tubo-ovarian mass. First outline the mass carefully by determining its exact relation to the uterus and the pelvic walls, on the right side bearing in mind the vermiform appendix and the colon; on the left side, most important of all, never forgetting the intimate relations of the sac to the rectum. If any fluctuation can be felt in the pus-sac, it is important to empty it with an aspirator to avoid the dangers of rupture and distribution of the pus in the peritoneum.

Enucleate—*a*, by working the finger or fingers in behind the mass and stripping it off from the posterior pelvic wall: this starting the tumor from its bed is often the most difficult part of the operation; *b*, catching the mass thus started and rolling it up from its bed of adhesions on the pelvic floor and the posterior surface of the broad ligament. This is an important step: to carry it out properly it is necessary to bear in mind that the ovary has become displaced by dropping down on to the broad ligament and then to the pelvic floor, performing a distinct act of rotation. In enucleating the ovary and tube must be unrolled in the reverse direction. An attempt to drag these structures up without thus unrolling will surely be disastrous. *c*, The delivery of the masses from the abdominal wound by continued gentle traction bearing equally on all parts of the pedicle.

5. Transfixion of the pedicle. If it is slender, two ligatures will be sufficient. Three or four interlocking ligatures will be necessary to secure a thick, fleshy pedicle. Do not take too much tissue in the grasp of the outer and inner ligatures (a precaution against secondary hemorrhage).

6. Checking all bleeding by suture and ligature.

7. Cleansing the abdominal cavity of all escaped fluids—*a*, by irrigation, when pus has escaped, with normal saline solution, 6 grams of

salt to the litre of water, temperature 43.3° C. (90 grains NaCl to the quart of water at 110° F.); *b*, when no pus has escaped by simply sponging out accumulated blood behind the uterus and posterior to and in front of the broad ligaments.

8. Closure of the abdominal wound—*a*, by uniting the peritoneum with a continuous catgut suture; *b*, uniting the recti muscles, fasciæ, subcutaneous tissues, and skin with interrupted sutures of silkworm gut.

9. Hermetically sealing the wound-area by a sterilized celluloidin dressing.

TUBAL DISEASES.

THE commoner diseases of the Fallopian tube are—

Hydrosalpinx, distension of the tube with a watery fluid;

Hæmatosalpinx, distension of the tube with bloody fluid;

Pyosalpinx, distension of the tube with pus;

Interstitial salpingitis, inflammation of the walls of the tube, acute and chronic.

Tubercular salpingitis;

Perisalpingitis, or inflammation associated with ovarian disease in the form of perioöphoritis and perisalpingitis (*q. v.*).

I only employ such terms as hydro-, hæmato-, pyo-salpinx with an apology, and the explanation that they have crept into such common use that any general practitioner consulting my article would be embarrassed to find the disease treated of under another more appropriate name. Do not forget that these names are simply *descriptive of the contents of the Fallopian tube*, and do not give us any information whatever as to the true nature of the disease itself, which in pus cases depends upon an invasion of the tube by various micro-organisms. A pregnant example of the importance of distinctions of this nature, based upon a microscopical and bacteriological examination, may be found in the following fact, which my clinical experience has given me abundant opportunity to verify: An old pyosalpinx caused by gonorrhœa may often be removed with impunity, even the free escape of pus over the surrounding sound peritoneum being followed by no serious reaction. In the case, however, of a post-puerperal pyosalpinx, where the tube contains streptococci, the escape of such pus into the peritoneal cavity in the course of an operation may be followed by a rapidly fatal peritonitis, and that, too, in spite of irrigation and a careful peritoneal toilet.

Here are two distinct diseases affecting the Fallopian tube, apparently to the naked eye identical, both having as a striking characteristic

clinical symptom the production of pus: one is a *salpingitis purulenta gonorrhoïca;* the other is a *salpingitis purulenta puerperalis.* The true difference lies in different cocci producing the disease.

Hydrosalpinx is caused by an inflammatory occlusion of the fimbriated extremity of the tube, the accumulated fluid distending its lumen and often causing the canal to kink, and thus presenting further obstacles to the egress of the fluid by way of the uterus. The modes of treatment are palliative or radical.

Palliative Treatment consists in rest, hot douches, keeping the emunctories active, and the use of the milder analgesic drugs—camphor, asafœtida, belladonna, cannabis indica, valerian, bromides—during exacerbations of pain.

Radical Treatment.—It is already claimed, probably with propriety, that by means of massage the contents of such a tube may often be evacuated, and after several such evacuations the accumulation does not tend to return.

Enucleation is the treatment most frequently practised. Here, after opening the abdomen, the adhesions connecting the tube to the intestines and pelvic wall must be carefully separated. A very large tube or one threatening to rupture should be emptied by an aspirator. The ovary is usually imbedded in a mass of adhesions: in these cases the disease is evidently no more a disease of the tube alone than of the ovary, the presence or absence of fluid in the tube being a purely accidental concomitant. After lifting the structures through the incision and out of the abdomen, the broad ligament is transfixed well below the disease, tied off, and the structures removed. A conservatism which attempts to save such a tube or a part of a tube is as yet purely experimental, and we have still to learn whether the disease will not return after such an effort.

Hæmatosalpinx.—The name "hæmatosalpinx" is applied to an accumulation of fluid blood within one or both tubes, not including ruptured extra-uterine pregnancy. Removal of the diseased tube is the only remedy known for this disease. The contents of the tube are sometimes septic, and great care must be observed to prevent the contamination of the neighboring peritoneum.

Pyosalpinx.—Pyosalpinx, or pus in the Fallopian tube, is rarely found apart from such an extensive pelvic peritonitis as involves the ovary in a mass of adhesions.

While pus can often be squeezed by the hand from a distended tube into the uterus, even in such quantities as to pour out of the vagina, it has not been established that the disease can in this way be cured. In fact, accumulations and intermittent discharges of pus are a part of the natural history of this disease.

The tendency of such tubes is to perforate neighboring organs,

especially the intestines: this tendency constitutes one of the most serious sources of danger in the only method of radical cure at present within our reach—the ablation of the diseased structures—for the finger of the operator may tear open the thinned-out coat of the bowel, into which the pus would have shortly discharged had no operation been performed.

The steps of the enucleation of a pyosalpinx are—

1. An abdominal incision in the linea alba, 6–8 cm. ($2\frac{1}{2}$–$3\frac{1}{4}$ inches) in length.

2. Freeing the tube from the adhesions on its upper surface, taking extraordinary care not to tear the bowel, and carefully suturing at once any unavoidable wounds thus made which continue to bleed.

3. Tapping a large tube or one distinctly fluctuating and evacuating its contents.

4. Elevation of the tube and ovary so as to form a pedicle.

5. Transfixing and tying the pedicle.

6. Burning out the little uterine end of the tube beyond the grasp of the ligature, so as to destroy any germs or pus lingering there.

7. Peritoneal toilet—*i. e.* cleansing the peritoneum of blood, clots, etc.

8. Closure of the abdominal incision: *a*, closing the peritoneum with a continuous catgut suture; and *b*, bringing together the rest of the incision with silkworm-gut sutures about three or four to the inch.

Interstitial Salpingitis, or inflammation of the walls of the tube, results in thickening, and is often associated with the production of pus, forming *pyosalpinx*, or it may continue without the formation of pus.

In the early stages, before the formation of pus, as evidenced by chill, fever, repeated attacks of pain, with hardening of the vault of the vagina due to surrounding peritoneal inflammation, the attendant can well afford to wait to determine whether with rest and due attention to the bowels and hygiene nature will not be able to throw off the disease by absorption.

It is a mistake to imagine, however, with our present deficient therapeutic armature, that we are able to determine the course of such a disease in the more favorable direction.

If suppuration occurs, the case then becomes a pyosalpinx, and must be treated as such (*q. v.*). If it remains as a chronic thickening of the walls, the character of further treatment will be determined by the ability of the patient to afford the luxuries of prolonged rest and constant medical attention. Patients of the poorer classes will much more frequently be compelled by their sufferings to seek early relief at the hands of the surgeon, who will endeavor to cure the pain by removing its tangible cause, the inflamed tube.

I must here expressly warn against undertaking this operation upon women who have been invalided for years. Prolonged invalidism from pelvic pains often develops a peculiar quasi-hysterical nervous wreck, and it will frequently be found that the sufferings apparently continue in spite of the most successful operation. The patients who have nursed their ailments so long seem also sometimes actually loth to part with them; I have heard women deny that an operation had helped them, in spite of marked improvement and amelioration of their symptoms.

The surgeon cannot be too frank with his patient beforehand, and should with the utmost care avoid raising a false standard of expectations. A restoration to absolute good health, while always his aim and hope, is not the rule in this class of patients. Frankly state that such improvement as makes life bearable is worth the effort; frankly state that it is possible that there will be no improvement whatever, and the patient will be grateful for any relief gained, instead of being soured by disappointment. Shun also the error of supposing, or leading the patient to suppose, that with the operation all necessity for further treatment will be at an end. The convalescence is often protracted over one or two years. I do not mean by this that the patient must wait this length of time to feel that she has been improved by her operation, but that the full benefit is appreciated better after six or twelve months than in six or eight weeks. If both sides are affected, as is usually the case, the removal of the tubes with the ovaries is followed by an artificially induced menopause, in which all the ordinary complaints of that period are present in an exaggerated degree. The nervousness, the flushes, the gentle perspirations, and the palpitations persist for six or eight months, and then gradually abate.

Tubercular Disease of the Tubes.—The treatment of tubercular disease of the tubes is intimately associated with the treatment of tubercular peritonitis: the tubes most frequently form the nidus of infection from which the tubercular process spreads to the neighboring, and then to the general, peritoneum. In these cases the intensity of the process is most marked in the pelvis, and particularly about the tube, the mesosalpinx, and the broad ligament.

The treatment should follow one of two courses—either, *a*, enucleation of the tube with the ovary adherent and involved in the disease, or, *b*, simply draining the abdominal cavity by the introduction of a drainage-tube through the abdominal incision down to the floor of the pelvis.

a. Enucleation.—This should be performed whenever practicable, when the structures are not too densely bound up in adhesions to seriously infected surrounding organs, and when the patient is not too weak from long continuance of the disease.

The results of enucleation, even in the worst cases with disease extending widely out into the peritoneum, are oftentimes surprising, the patient being completely restored. The tube in advanced tuberculosis is brittle and easily torn. Care must therefore be exercised not to drag upon it too forcibly. It is better to tie off the pedicle lower down in the abdomen, using a number of ligatures. The peritoneum must be sponged dry of all the fluid accumulation almost invariably found associated with this disease, and a glass drainage-tube inserted, reaching down into the pelvis when the abdominal incision is closed. (This use of drainage is universal, but the writer questions very much the benefit arising from it.) A loose gauze plug reaching down to the bottom of the tube, with its outer end resting upon some sterilized cotton, acts as an admirable capillary drain, constantly drawing fluid up from the pelvis and discharging it outside.

b. DRAINAGE.—Where the structures cannot be removed, owing to density of adhesions or the profoundly prostrated condition of the patient, the operator should then deftly empty the abdomen, through a small incision (4–5 cm.), of all its accumulated fluid, and at once slip in a drainage-tube, close the wound down to the tube, put the gauze plug in the tube, and apply the dressing and the binder. Drainage should be continued as long as there is an active flow of fluid from the tube; that is, from three days to a week.

After the tube is removed the tube-track collapses, but there is in these cases a peculiar tendency to leave a fistulous sinus which is weeks or months in closing completely.

Convalescence is protracted, but the recovery is usually perfect, and there seems to be but slight tendency to tubercular deposits elsewhere, so that the surgeon need not hesitate to give a favorable prognosis.

OVARIAN DISEASES.

THE commoner ovarian diseases calling for treatment are—

Infantile ovaries; Dislocated ovaries: *a*, hernia, *b*, displaced to pelvic floor, *c*, displacements upward; Perioöphoritis with adhesions; Cirrhotic cystic ovaries; Small cystic ovaries; Graafian cyst; Cyst of the corpus luteum; Hæmatoma of the ovary; Oöphoritis; Abscess of the ovary; Ovarian cystoma, simple and papillary: *a*, polycysts; *b*, monocysts; Parovarian cyst; Dermoid cyst; Sarcoma ovarii; Carcinoma ovarii.

There is no specific medication for any disease of the ovaries, in spite of all assertions to the contrary, and the present-day medical treatment

of such diseases is in the highest degree irrational, for there is rarely an attempt to make an accurate diagnosis, the presence of ovarian disease being oftenest assumed in its absence. If this statement as to the futility of specific medication holds good for those lesser diseases in which the ovary is not greatly increased in size, it is true *a fortiori* in those neoplastic diseases in which the ovary steadily increases in size, first filling the pelvis, then becoming an abdominal growth, and at times even surpassing in size all the rest of the viscera taken together. In these latter affections the uselessness of drugs has been so often demonstrated, and the disastrous effects of waiting are now so universally known, that I do not hesitate therefore to pronounce such attempts unjustifiable. While denouncing the specific medication of to-day I would praise the usefulness of those drugs which we use "on general principles" for the pain, for anæmia, for alterative and general tonic effect. In the effectual employment of such remedies to supply and repair tissue-waste, to tone up the enervated, to combat the train of secondary maladies, such as indigestion, palpitation, constipation, headache, etc., the judgment of the general practitioner is often keener than that of the specialist. In this field, in an indirect way, medicines have a wide scope and do excellent work.

It must be constantly borne in mind that the term "ovarian neuralgia"—"ovaralgia"—has no pathological basis, and the pain thus felt and definitely located is met with in a variety of diseases or even where there is no disease at all.

In inflammatory diseases affecting the ovaries the general principles governing the treatment of inflammations elsewhere are applicable also. The most important arm of the treatment in the acute stages of the affection is a reliance upon the *vis medicatrix naturæ*. With patient waiting nature will often cut the attack short, and by a removal of many of the fresh inflammatory products will alleviate the most distressing symptoms. When the disease has passed into the chronic stage, unaided nature seems helpless; here the solvent action of electricity or the stimulation of massage or the mechanics of surgery steps in as curative or as a valuable adjuvant.

Infantile Ovaries.

There is no treatment for this condition, which is oftenest associated with an infantile undeveloped uterus. The pains which are the molimina of an incompletely developed organ endeavoring to perform virile functions are best combated by sedatives. Where the pains are purely periodical in their appearance there is even no serious objection to one or two hypodermic injections of the sulphate of morphine ($\frac{1}{6}$ to $\frac{1}{4}$ or $\frac{1}{2}$ grain). A continuous use of any of the opium preparations must be avoided from the first, being reprehensible here

as in any other pelvic disease. Bear in mind that in cases in which no sedative drug has ever been used patients who have thus suffered every month for many years often retain blooming health. There are more wrecks from inoculation of the patient with the morphine habit than there are from the disease itself. There is a peculiar tendency in ovarian pain to induce hysteria, and the best gauge of the amount of pain is not always the movements and the expressions of the sufferer. A keen eye will detect the difference. Where the pain persists and incapacitates the patient for the duties and enjoyments of life, surgery should be resorted to and both ovaries and tubes removed.

Dislocated Ovaries.

Under this term we include—

a, Hernia of the ovary into the inguinal canal;

b, Downward displacement to the pelvic floor, so-called "prolapsed ovary;"

c, Displacement of the ovary effected by inflammatory adhesions.

I will not refine my classification so far as to include ovaries displaced by enlargement of an ovary or part of an ovary or displacement of the uterus.

a. **Hernia of the Ovary.**—The commonest form is hernia into the inguinal canal. An ovary in this situation must be carefully protected from pressure or blows by proper padding of the clothing. At the monthly periods pain in the ovary may be relieved by resting with flexed thighs and by hot applications directly over the tender organ.

A tendency to morbid enlargement should be promptly recognized and followed by extirpation. The steps of the operation are simple:

1. Incision through the skin and subcutaneous tissue, 3–4 cm. in length, directly over the ovary.

2. Cutting carefully down between the pillars of the inguinal canal.

3. Opening the peritoneum just enough for the small axis of the ovary to pass through.

4. Making such pressure behind the ovary as will deliver it out of the incision, and separating any adhesions holding it in its bed.

5. Sufficient traction upon the ovary to form a pedicle on its proximal side, and transfixion and ligature in the ovarian plexus.

6. Closure of the peritoneal wound with continuous catgut suture, and closure of the skin and fasciæ with silkworm-gut sutures; the application of a sterilized collodion dressing, hermetically sealing the wound; a cotton pad and a spica bandage complete the dressing, which need not be disturbed for a week.

b. **Displacement of the Ovary on to the Pelvic Floor.**—This is in no sense a "prolapsus" and in no sense a "hernia;" it is a *descensus*,

most frequently found associated with and caused by retroflexion or retroversion of the uterus, when the ovary lies imprisoned beneath the displaced womb. It requires no stretch of the imagination to realize that the periodical congestions of an ovary imprisoned below a retroflexed uterus would naturally be painful, and that the tenderness should in time become intermenstrual as well as menstrual. In these cases a reposition of the uterus effects a replacement also of the ovaries and the symptoms cease. When, however, no other pelvic abnormality than a downward displacement of one or both ovaries is present, the associated symptoms of weight, aching, backache, lassitude, cannot be attributed with such certainty to this frequently-found abnormality, for such displacements are often enough found where no disagreeable symptoms are present. Congestion and dilatation of the blood-vessels may have much to do with the production of the symptoms, but the fact is by no means established. It is therefore doubtful how far we are justified in directing a vigorous treatment against the ovaries themselves.

I have absolutely no confidence in a simple bimanual reposition of a displaced ovary, or in the special utility of any of the gibbous pessaries designed to avoid making pressure on the tender organs. Better results are to be obtained from the use of hot douches and local treatment in the form of free depletion of the cervix to the extent of about 15 cc. ($\frac{1}{2}$ ounce) of blood, repeated every seven to ten days in the intermenstrual period, while the depletory effect of a boroglyceride pack (absorbent cotton saturated with 6–8 cc., $1\frac{1}{2}$ to 2 drachms, of the solution) against the cervix, sustained by a springy wool pack below, is used every three or four days in the intervals. In whatever way produced, the effect of this treatment is excellent and the relief often prolonged and lasting.

c. **Displacements due to Inflammatory Adhesions and Ovaries adherent in situ normali.**—Such displacements are usually the result of a widespread pelvic inflammation involving the tubes as well as ovaries, and as such are treated under Tubo-ovarian Diseases.

Where the adhesions are not dense the ovary may be released by anæsthetizing the patient and breaking the adhesions or stripping the ovary off from its attachments by the index or index and middle fingers introduced high up within the rectum behind the uterus, while the counter-resistance is afforded by the abdominal hand compressing the tissues above down on the ovary, as already described. Rest in bed should be enjoined for a week after such an operation.

Cirrhotic Ovaries.

No treatment affects this condition, which is not a disease, and the gynæcologist should be loth to open the abdomen for the removal of cirrhotic ovaries. The only indication for operation is the persist-

ence of pain severe enough to make the patient's life burdensome. Under such circumstances the operation is perfectly justifiable and its results sometimes brilliant.

Multiple Small Cysts of the Ovary.

These are simply enlarged Graafian follicles which attain a diameter of from ½ to 1 cm. Their significance is not understood. They are most frequently found associated with long-standing pelvic inflammatory disease. Operation for this condition alone is never justifiable.

Enlarged Graafian Cyst.

I introduce this affection, unnoticed in the textbooks, because of the frequency with which I have met it. The Graafian follicle sometimes increases in size until it is 2–3 cm. (about 1 inch), or 4 or 5 cm. (about 2 inches) in diameter, or even fills the whole pelvis. It thus forms a single large thin-walled, limpid cyst, usually bound to the pelvic walls by some adhesions. The persistent pain and disturbance of the general health are remarkably out of proportion to the apparently simple nature of the affection.

Operation is the only method of affording relief. It is probable that the intentional rupture of these cysts, recognized in the bimanual examination through the rectum by their uniformity, their fluctuation, and their thin walls, would be followed by no serious reaction, and possibly by relief equal to the much more formidable extirpation by the abdomen.

The only hindrance to recommending such a course is the uncertainty in the diagnosis, which can only be made by the most practised diagnostician. The writer has ruptured several such cysts without harm to the patient. Where the rounded prominence of the cyst can be distinctly felt close to the vaginal vault, tapping is a better procedure than abdominal section, which can always be performed later in the event of refilling and continuance of the pain. I am opposed to exploratory puncture, and such a use of the aspirator is in no sense exploratory, for it is employed after forming the diagnosis when the needle is carried into the sac, just as definitely as an incision made with a knife with the distinct purpose of evacuating the sac.

Safe and simple as such an operation is when properly performed, it can easily be made dangerous if undertaken with neglect of necessary precautions. The steps are the following:

1. Anæsthesia, only necessary in a nervous, sensitive patient.
2. Posture of the patient is an exaggerated lithotomy position, with thighs well flexed on the abdomen and buttocks resting on the edge of the bed or table on the writer's perineal cushion.

3. Thorough cleansing of the whole external genital and vaginal tract with soap and water.

4. Location of the most prominent part of the tumor *behind the uterus* with the index finger. (Avoid the lateral fornices.)

5. Incision of the vaginal mucosa with a straight, sharp bistoury carried in and guarded by the index finger. This avoids the most difficult and painful part of the puncture. The difficulty of plunging the point of the aspirator through the tough vaginal mucosa is often considerable, and may even displace the cyst out of the reach of tapping.

6. Introduction of the trocar-point through the little incision, pushing it steadily on into the cyst. Withdrawing the trocar from the canula, and aspirating. Care must be taken not to push the trocar too far, lest it penetrate the opposite as well as the adjacent wall of the cyst and result in a dry tap. It must be borne in mind, too, that the canula can impinge against the cyst-wall and the flow cease while considerable fluid still remains in the cyst. This will be recognized by a sudden stoppage in the flow or an intermittent, jerky flow.

7. After tapping, a loose pack of iodoform gauze (5 per cent. iodoform) is introduced into the vagina and the patient put to bed for a few days or a week. The gauze should be removed in thirty-six hours and nothing further done to the vagina. The bowels should be kept well emptied and soft and liquid diet given. It is a mistake to give patients confined to bed the same quality and quantity of nourishment as those who are engaged in all the activities of ordinary daily life.

Removal of the cyst by abdominal section is usually one of the simpler abdominal operations. A large thin-walled cyst should be tapped before attempting to remove it, thus avoiding the certain rupture and escape of the fluid, as well as the necessity of making a large incision. Drainage should not be used.

Sometimes such cysts can be safely exsected, leaving the remaining sound part of the ovary. The line of the excision is closed by sutures.

Cyst of the Corpus Luteum.

This disease is also frequent. The cyst thus formed resembles in its relations and its size and external appearance the cyst of the Graafian follicle just described and the treatment is in no way different.

Hæmatoma of the Ovary.

This may be either multiple or single, forming no tumor at all or forming a tumor as large as a hen's egg. This condition can only be

treated directly by abdominal section, and the discovery of the nature of the disease is usually incidental, the operation having been undertaken for other reasons. In a case of the author's a persistent, uncontrollable uterine hæmorrhage made removal of the ovaries imperative: these were found studded with small blood-coagula into the Graafian follicles.

Oöphoritis.

This is not a simple, uncomplicated disease. Although it is an affection of grave importance, profoundly affecting fecundity as it does, yet the opportunity does not arise to treat the disease as such. Inflammation of the parenchyma of the ovary arises in the course of grave post-puerperal affections in common with uterine and tubal disease, and general septic infection, and from infection conveyed direct *per tubam*, and for the time being the efforts of the practitioner are directed simply toward saving the life of the patient. In its after-history the disease is closely connected with chronic pelvic peritonitis and tubal disease, both ovary and tube being bound down by adhesions, or it passes into ovarian abscess (*q. v.*). In the former case the consideration of the propriety of enucleation comes up, as discussed under Chronic Inflammation of Tube and Ovary.

Abscess of the Ovary

forms a large round sac, in size and shape and relation like the enlarged Graafian cyst, but its walls are much thicker and fluctuation far from being so distinct.

The only rational treatment of a pelvic abscess is evacuation or enucleation of the whole cyst—not so much because of the danger of rupture into the peritoneum, which has been over-estimated, as on account of the indefinite protracted invalidism to which the person harboring the abscess is condemned. The effects of slow absorption of the pus-products are but too evident in their ravages upon the general health.

a. When such an abscess projects into the vault of the vagina the procedure of opening and draining from below is commendable, and in the event of the partition dividing the cyst from the vaginal vault being thinned out it is the only proper procedure. Under the latter circumstances a pair of sharp-pointed scissors or a knife may easily be plunged in—indeed, the finger may sometimes be thrust through—and a free exit for the pus established and carefully kept open afterward by passing in bougies or dilators every two or three days. The cyst should be gently washed out every few days, or even daily, with a 2 per cent. warm carbolized douche passed through a two-way

catheter. In the course of several months the walls contract and the cavity becomes obliterated. The ovary remains adherent to the pelvic floor, usually giving rise to no distressing symptoms.

b. The abdominal operation for enucleation of the sac, as well as removal of the pus, is more dangerous—dangerous on account of adhesions between the ovary and neighboring viscera, and dangerous because the character of the pus must be unknown until microscopically examined, the rupture of a sac containing streptococci adding greatly to the dangers. I have demonstrated this in several instances. We are therefore never justified in representing the abdominal operation as innocuous and safe. This avenue must be chosen when the ovarian tumor does not present those characters described in the last section. In the absence of a definite, well-rounded, convex, fixed prominence encroaching upon the vaginal vault, which we might say invites operation from below, the superior or abdominal operation must be selected.

The steps are—

1. An abdominal incision in the linea alba 6–8 cm. (2–3 in.) in length.

2. Palpation of the upper surface of the tumor, inspection of the adhesions, and gentle separation of omentum and intestines from the convexity of the tumor.

3. Tapping the tumor with the largest trocar and canula (2 to 2.5 mm.), and aspirating all the pus; immediate closure of the puncture upon withdrawal of the canula.

4. Separation of the tumor from its bed of adhesions, beginning by working the fingers down between the sac and the posterior or postero-lateral pelvic wall, working the fingers under it, and then rolling it upward in the upper border of the broad ligament as an axis, delivery from the abdominal incision, transfixing, and tying of the pedicle.

5. Irrigation is always necessary where any pus has escaped in the enucleation. The distribution of this pus should be guarded against in every possible way before its escape by pushing the intestines up and by placing a few soft sponges down about the tumor, and, if any pus is seen to escape, by removing as much of it as possible at once with a sponge. After the removal of the tumor the sponge should be lifted out, cleansed, and the pelvis gently sponged thoroughly clean. Then the incision should be held widely open with retractors, and by making a gutter of two or three fingers behind the uterus, with their dorsal surfaces applied against the promontory of the sacrum, one or two litres (quarts) of a normal salt solution (6 grammes to 1000 cc. water) (90 grains to the quart, temperature 43° C = 110° F.), poured in, and the pelvis and lower intestines thoroughly washed by stir-

ring the water about with the fingers or with a small sponge on a holder.

It is a technical error to irrigate and wash out the whole abdominal cavity when but a little pus escapes into the pelvis. Such extensive irrigation should be practised only in the event of large uncertain amounts escaping among the intestines. This will not often be necessary if the abscess is aspirated before removal.

6. After irrigation dry out the pelvis thoroughly, take a clean sponge, and pass it under the abdominal walls up toward each renal region, making a little counter-pressure on the outside to bring any fluid toward the sponge; sponge out both iliac fossæ, and carefully wipe out the vesico-uterine pouch.

7. Bring down the omentum and close the abdominal incision by a continuous catgut suture for the peritoneum, and sutures of silkworm gut for the muscles, fasciæ, and skin.

8. The dressings and after-treatment as in other cases.

With the complete removal of the disease in this way health soon returns.

Ovarian Cystoma.

Ovarian cystoma is the classical ovarian disease.

The treatment of such affections should in all cases be preparatory to a complete extirpation of sac and contents, the sole object being to get the patient in the best possible condition for the operation. There is no particular time in its history or size in its growth when an ovarian cystoma should be extirpated. If recognized before it is large enough to escape from the pelvis, then is the most favorable time to operate; then the complications are apt to be fewest before the digestive function and nutrition have become so profoundly affected as they are later in the course of the disease.

There is no use, and much harm, in waiting for such illusionary advantages as inuring the system to the disease, accustoming the peritoneum to insult through attacks of peritonitis, and constant friction of the cyst-wall on the parietal and visceral peritoneal surfaces. Medication, other than general systemic strengthening, is folly. Electricity and massage can do nothing but harm. Tapping under ordinary circumstances should never be resorted to, for by this means peritonitis is excited, hæmorrhage into the cavity of the cyst is provoked, malignant contents, so common in these doubtfully benign, doubtfully malignant growths, may thus be sown broadcast over the sound peritoneum, and moreover the cysts always fill up again; the tap cannot empty the small cysts, and whoever has seen the glistening surface of an ovarian cyst often traversed by huge veins just under the linea alba would be inclined thereafter to look upon a tapping of election as a foolhardy running of risks.

Tapping is allowable in cysts of enormous size where the operator fears to remove such a tremendous pressure and support suddenly from the portal circulation and the diaphragm. This tapping should precede the operation by but a few days, and the withdrawal of the fluid substituted by compresses and bandages. Other things being equal, put the patient at rest, stimulate her skin, her bowels, and her kidneys, know exactly the state of the latter, both as to the amount of urine secreted daily and the presence of albumin or casts, and operate at once.

The writer thus operated upon a tumor weighing one hundred and sixteen pounds, with restoration of the woman, who had long been a mere appendage to her larger parasite, to perfect health.

The steps of the operation are—

1. An incision 7–10 cm. (3–4 inches) in length, in the linea alba, halfway between the umbilicus and pubes over the lower convexity of the tumor, opening the peritoneum and exposing the glistening white surface of the thick cyst-wall. The intestines have all been displaced upward by the tumor and do not appear.

2. Tapping. The puncture of the cyst with a bistoury, stopping the hole for a moment with the finger, withdrawal of the finger, and plunging the large canula (Hodge's) into the cyst. The contents pour down into the bucket, and as the cyst-wall becomes flaccid it is seized with forceps and held up in the incision while an assistant keeps up gentle pressure in both flanks, forcing the fluid into the canula. The largest division of the cyst always lies in front, and if high up to the right side (a simple matter of accommodation due to form), and with its evacuation either the rest of the cyst can be everted, or by introducing a finger the septa of a few smaller cysts are broken, and their contents thus evacuated and the whole mass then drawn out.

3. Adhesions binding the cyst to the abdominal wall or the abdominal or pelvic viscera must be carefully separated, always observing the principle of sacrificing the cyst-wall for the benefit of its host. The omentum alone may be freely sacrificed. Pelvic adhesions must be treated with especial care, to avoid wounding large venous trunks.

4. Ligating the pedicle. If not more than 2–3 cm. broad, or if very flat 3 or 4 cm. broad, the pedicle may be simply transfixed with a double ligature and tied both ways, but a broader or a thick, fleshy pedicle should never be trusted to two ligatures. Here safety is only to be found in several.

5. Where fluid has escaped from the tumor and there is blood in the abdominal cavity, it is an excellent plan to wash it out thoroughly with normal salt solution, temp. 43, C., poured freely in. This has an excellent stimulating as well as cleansing effect.

6. The abdomen is sponged dry and closed with two layers of

sutures—a separate continuous catgut suture for the peritoneum and interrupted catgut sutures for the muscles, fasciæ, and skin.

7. The application of the dressing of sterilized collodion to the wound.

8. The application of the binder and putting the patient to bed.

Parovarian Cyst.

The treatment of this disease is also by enucleation. It is true that in the case of parovarian cysts accidental blows have ruptured the cyst intra-abdomen, and absorption of the fluid has resulted in a cure; it is also true that a single tapping has cured such cases. In spite of these facts, there is a dangerous tendency on the part of parovarian cysts to malignancy, evidenced by the papillary masses frequently found lining their walls, and no physician is justified in assuming such a risk in view of the safety of extirpation.

Extirpation is practised as just described in the enucleation of the simplest kind of an ovarian tumor in the preceding section.

Dermoid Cyst.

A dermoid cyst is a most dangerous parasite, and extirpation is the only proper plan of treatment.

These cysts are peculiarly liable to attacks of inflammation, glueing them down to all surrounding organs, or they are even occasionally liable to suppuration and perforation into the neighboring viscera. The great difficulty, therefore, to be encountered at the operation is the number of dense adhesions, which must be slowly and patiently dealt with, always sacrificing the cyst-wall rather than any abdominal viscus.

Sarcoma Ovarii; Carcinoma Ovarii.

These malignant diseases call for speedy removal. When taken in their earliest stages the probability of a relapse is slight, for they are localized. One important precaution to be taken is to form a pedicle at as great a distance as possible from the tumor.

It will sometimes happen that these diseases will be first discovered after relieving the abdomen of a quantity of ascitic fluid by tapping. It is much more satisfactory, however, to follow the writer's practice of making the tapping an exploratory operation, and ascertaining at the same time the nature of any obscure abdominal disease. In other words, instead of plunging a trocar into the abdomen, to make an incision $2\frac{1}{2}$–4 cm. (1–$1\frac{3}{4}$ inches) long, rapidly and perfectly evacuate the fluid through this, and then carry in one or two fingers and explore the abdominal cavity.

Neither of the diseases in question should be touched when it has spread beyond the original focus, the ovary. When thus limited the operation of enucleation is quite simple, resembling the removal of an ordinary ovarian cyst.

Prospective.—It cannot be reasonably expected that the future will supply our armamentarium with drugs of any value in curing these diseases. Such an idea is almost utopian, belonging more to the mystical pathology of the past.

Although we have no prospect of finding any such alchemical remedies, a wider and better field remains for our successors, who, armed with the knowledge we have given them of the infectious nature of the inflammatory diseases, will exercise the nobler faculty of preventive medicine, and will observe many cases of cancer in their incipiency by keeping patients whose family history points in this direction constantly under observation.

In the milder pelvic complaints there is even now a reaction against surgical methods and a laudable effort to find new avenues of treatment and cure.

DISEASES OF PREGNANCY, PARTURITION, AND OF THE PUERPERIUM; EXTRA-UTERINE PREGNANCY, AND ABORTION.

By BARTON COOKE HIRST, M. D.

PREGNANCY, PARTURITION, AND THE PUERPERIUM.

In this article will be presented first a sketch of the medicinal treatment demanded by the majority of pregnant, parturient, and puerperal women, although the childbearing process may not in them be called complicated; next the medicinal treatment of complications in the childbearing period.

Pregnancy.

Constipation is more frequent in the pregnant than in the non-pregnant woman. Inactivity of the bowels is more than a disadvantage or a discomfort, for extra work is thrown upon the kidneys, already perhaps overburdened, and kidney insufficiency with its attendant dangers becomes more probable. The majority of pregnant women, therefore, need laxatives. A drug or drugs must be selected that will not violently purge, for gestation might be thus interrupted, and that can be used for a long period without ill effects, for the constipation is usually intractable till the pregnancy is terminated. I employ more often than anything else the fluid extract of cascara sagrada in 20–30-drop doses at bed-time. This dose may be repeated twice or thrice daily if necessary. The smallest dose of a laxative, repeated as seldom as possible, should be the rule in treating constipation, whether in pregnancy or not. A pill of aloes, strychnine, and belladonna is useful, but its prolonged employment is not advisable. It makes a good alternative with the cascara when the latter begins to lose its effect.

The diet must at the same time be regulated and habits of regularity advised. In the worst case of constipation I have ever seen in pregnancy there had been but one movement in three weeks, the patient eating pretty heartily all the while. I gave an ounce of castor oil and four compound cathartic pills at once. The evacuation was enormous, but the pregnancy was not disturbed.

Tonics and roborants are often useful during pregnancy. Any

woman who is not remarkably plethoric or vigorous is, I think, the better during the last month or two of pregnancy for a little iron and phosphate of lime in a vehicle like malt extract, and the child is benefited perhaps more than the mother.[1]

Labor.

In normal labor no internal medication is indicated as a rule. If one believes in the much-vaunted efficacy of quinine in strengthening labor-pains, perhaps he will employ the drug as a routine practice: for myself, I have no faith in it. I gave it for a time in almost every case, and had my hospital internes administer it regularly, but, failing to see any marked result in a single case, I have discontinued its use.

The use of analgesics, demanded, as a rule, in the parturition of civilized women, may best, I think, be considered under this head—the medicinal management of normal labor.[2] Chloroform and ether are the only practicable agents to diminish the pain of labor. Other substances, used by inhalation or local application, have been tried from time to time, but no longer deserve to be employed. Of the two agents named above, chloroform has the stronger recommendation and is more generally employed than is ether. I am in the habit, however, of using the latter exclusively, and can speak from experience of it alone. Ether is perfectly safe and without disadvantages if not used too long and in too great quantity. One avoids the first danger by beginning the administration only just before the second stage of labor or when the cervix is about to be stretched to the utmost, and avoids the second by holding a well-saturated handkerchief to the patient's nose and mouth at the first intimation she gives of an approaching pain, withdrawing it as soon as the pain has passed away. The administration can be entrusted to the nurse or the husband with perfect safety if these precautions are observed. In this, I think, ether is superior to chloroform. I should hesitate to allow an inexperienced person to administer chloroform, whereas with ether I have no anxiety whatever, no matter who gives it, as long as complete anæsthesia is not produced; and this is not necessary. A few deep inspirations of ether will make the head swim, take the edge off the pain, and make the woman comparatively indifferent to suffering. As the labor draws to a close the pains recur so frequently that if ether is given with each one an almost complete anæsthesia is induced when it is most needed, as the head is distending the vaginal outlet.

[1] It has been claimed recently that the routine administration of strychnine in the latter part of pregnancy will increase the strength of uterine contractions and shorten the duration of labor. This has not yet been clearly demonstrated.

[2] For the most comprehensive and thorough study of anæsthetics and analgesics in labor to be obtained anywhere, the reader is referred to the article by J. C. Reeve, M. D., in the *American System of Obstetrics*, vol. i.

Directly after the expulsion of the child, or, in case there is special reason to fear post-partum hæmorrhage, as soon as the head is born, a drachm of the fluid extract of ergot is given in water. In case the stomach is irritable the ergot may be given hypodermically. There are many general practitioners who say that the routine administration of ergot after labor is unnecessary, but they have not been called upon perhaps to control bad hæmorrhages at this period. Any one who has been obliged to cope with this most trying accident in medical practice will not be likely to neglect any simple precaution calculated to prevent it. And that ergot, given in the manner advised, will do this cannot be doubted. By the time that one is ready to express the placenta—namely, about fifteen minutes after the child is born—the drug is beginning to exert its influence upon the womb, so that firm contraction is almost assured during the period in which hæmorrhage might be likely to occur.

Puerperal State.

In the puerperal state the only routine medicinal treatment required is addressed to the bowels and to after-pains. It is almost always necessary to administer a laxative after confinement. The best time for the artificial evacuation of the bowels is at the end of the second day. On the following day the milk-secretion is expected. The sudden determination of blood to the breasts—a phenomenon exactly like acute congestion—is apt to cause discomfort and pain, if it does not pass the boundary-line of inflammation. The partial derivation of blood from the breasts by the action of the bowels keeps the congestion and engorgement of the mammæ attendant upon the institution of milk-secretion within physiological bounds. In multiparæ after-pains are so common as to demand attention, in the majority of cases at least. These pains depend upon the fact that blood is leaking out of the uterine sinuses into the uterine cavity, where it collects until the uterine muscle is incited to vigorous contraction to expel it. These contractions are painful. The indications for treatment are plain: the uterine muscle must be excited to a firmer contraction to prevent further leakage and to expel the blood already in the cavity; and to mitigate the pain of the contractions an analgesic is required. I am in the habit of meeting these indications by the use of 20 drops of fluid extract of ergot and a drachm of paregoric, repeated every few hours until, if necessary, four doses have been given.

PATHOLOGICAL CONDITIONS IN PREGNANCY.

For many of the complications in pregnancy mechanical or operative treatment is required: drugs alone are not called for. In the following account, therefore, of the diseases of pregnancy, only those pathological conditions will be described which are amenable to medicinal treatment.

Rheumatism of the Pregnant Uterus.—There is met occasionally in obstetric practice a painful condition of the uterus during pregnancy, and also in the puerperium, which seems to depend upon rheumatism of the uterine muscle. The first case of the kind I saw puzzled me greatly. There was abdominal pain, deep-seated and so severe that the woman was obliged to remain in bed. There was irregular fever of a low grade and a rapid pulse. No physical signs of disease could be detected anywhere. After trying several plans of treatment, salicylate of sodium was given in full doses. The effect was almost immediate. The pain disappeared and the temperature sank to normal. After some months the patient was delivered. In the puerperal state the pain and fever returned, but were again driven away by the salicylic acid, without other treatment.

Metritis.—Metritis complicating pregnancy has existed before conception. The diseased uterus is heavier and less pliable than common, consequently there is a sensation of weight and heaviness in the pelvis, often actual pain, and usually distressing and obstinate vomiting, which in some cases may indicate the induction of abortion, if, indeed, pregnancy is not spontaneously interrupted by the accidents attendant upon the congestion of the womb and its lining membrane. The only medicinal treatment available is the application of glycerin tampons to the vaginal vault and the use of laxatives to prevent constipation. The former treatment may possibly induce abortion, and the physician must warn his patient of the slight risk incurred.

Diseases of the Cervix.—Cervical endometritis is quite common in pregnancy, especially in multigravidæ who have suffered a laceration in a previous confinement. The increased congestion of the part consequent upon gestation induces an excessive activity of the mucous membrane, and there is profuse discharge of muco-pus, perhaps mixed with blood. It is in these cases that there is occasionally a monthly bleeding throughout pregnancy. The access of blood at the menstrual epoch occasions an oozing from the already much-congested mucous membrane of the cervical canal. In itself, the discharge from the vagina is disagreeable and uncomfortable to the patient, and will often require treatment. A good result may usually be obtained by injections of weak sulphate-of-zinc solution, 1 grain to the ounce, or of corrosive-sublimate solution, 1 : 8000. There is some little risk of inducing abortion by these

injections, so that the patient must be instructed to use the vaginal nozzle of the syringe employed, and not to allow the fluid to be projected into the vagina with any degree of force, but as gently as possible. One of my medical friends was threatened recently with a suit for malpractice because the treatment above described seemed to interrupt pregnancy. The abortion, however, may have been a mere coincidence or the patient may have disregarded the physician's injunctions as to the manner of giving the douche; but the possibility of involvement in a disagreeable case of this kind should make one cautious. If the endocervicitis is not relieved by an astringent injection, local applications are required. The best medicaments in such a case are nitrate of silver, 20 grains to the ounce, or peroxide of hydrogen in full strength or diluted one-third with water. An ingenious method of making applications to the cervix without incurring a risk of inducing abortion is to use a cylindrical speculum. After insertion the cervix stops up the lower end, and by pouring into the speculum a solution the cervix and its canal are subjected to the action of the agents employed.

The Diseases of the Vagina complicating pregnancy are due to an increased blood-supply or to specific infection. If to the former cause, they may be any of the hyperplastic inflammations or changes to which the vaginal mucous membrane is subject, including colpohyperplasia cystica.[1] The symptom common to them all is discharge of muco-pus, associated, perhaps, with a burning, itching, tingling, or heavy sensation. The treatment is the same as for endocervicitis, with the same precautions.

The specific infectious diseases of the vaginal mucous membrane are gonorrhœa and syphilis. They are both likely to assume very active forms on account of the increased blood-supply to the parts. The former is to be treated energetically to guard both child and mother from infection during and after labor. Copious douches of corrosive sublimate, 1 : 2000, are ordered twice daily, to be followed by the injection of a little plain water to wash out any residue of the sublimate solution. After each douche the vagina is to be tamponed with antiseptic wool which has been thoroughly dusted with tannic acid.

In syphilis complicating pregnancy the primary sore may assume an almost malignant character, and mucous patches may convert the vaginal mucous membrane into practically one great ulcer. The discharge from these cases is most offensive, and the women, in hospital practice, should be isolated, for they are virulently infectious. General and local specific treatment should be energetically carried on. After labor there is great danger of general septic infection, and one has a hard fight, sometimes, to prevent it.

The Diseases of the Vulva in Pregnancy are due to an increased

[1] Furthmann, *Inaug. Dissert.*, Marburg, 1890.

blood-supply. They are hæmorrhoids, vegetations, and pruritus. The first are scarcely amenable to treatment until pregnancy is terminated. They should be protected from injury, that they may not rupture.

Vegetations of the vulva, if limited in extent, with a small pedicle, may be ligated and snipped off or destroyed with chromic acid. But it must be remembered that any operative interference in this region might terminate pregnancy. If the vegetations are very extensive, as is not uncommon, they had best be let alone until after delivery, when possibly they will disappear spontaneously. In the mean time, a dry antiseptic powder may be employed, such as iodoform or salicylic acid and starch, 1 part to 5.

Pruritus Vulvæ may become aggravated after impregnation or may arise in consequence of pregnancy. It is a most intractable affection. Its treatment belongs to gynæcology. It is occasionally necessary, when the disease complicates pregnancy, to consider the induction of abortion.

Diseases of the Alimentary Canal dependent upon Pregnancy.

Mouth.—Caries of the teeth in consequence of pregnancy is quite common. I have thought that it could be prevented, or at least limited, by the exhibition of phosphate of lime, iron, and a general tonic. It is not wise to counsel dental operations during pregnancy, for abortion may result. Let the patient decide for herself after being told of the possible, but not likely, consequences.

Toothache of the severest character may complicate pregnancy, either with or without pathological changes in the teeth. It may resist the ordinary treatment in the most obstinate manner, and may not subside until the latter half of pregnancy has been reached, when it often disappears spontaneously.

Ptyalism is a rare complication of pregnancy. It may be most distressing by the large quantity of saliva running constantly from the mouth and by the drain thus imposed upon the system. It is often but little amenable to treatment. Astringent mouth-washes, with the internal administration of chloral, belladonna, and ergot, have been recommended, but one must wait in many cases for the termination of pregnancy to effect a cure. The ptyalism may be purely hysterical. I have seen it recur in five successive pregnancies in one individual who was of a highly neurotic character and in whom there were other signs of hysteria.

Stomach.—The vomiting of pregnancy is the single pathological condition which will be considered under this head.

To avoid a confusion which often leads to disastrous results in general practice, three divisions of the vomiting of pregnancy should be

made—namely, physiological vomiting, exaggerated vomiting, and pernicious or uncontrollable vomiting. The importance of bearing in mind these divisions can be thus illustrated: A general practitioner meets perhaps with several cases of *exaggerated vomiting;* he regards them as pernicious; he adopts possibly several plans of medicinal treatment, perhaps is driven for a while to rectal alimentation, but the patient recovers. The practitioner thereupon conceives the idea that all these cases are amenable to medicinal treatment, and that the induction of abortion should never be called for. His next case, maybe, is one of true uncontrollable vomiting. He persists too long with medicinal treatment, and the woman dies. I have seen this in consulting practice often enough to be convinced that it is a common mistake. The opposite error of course is also possible—the unnecessary induction of abortion for vomiting that is simply exaggerated—but is, I should say, not so common.

The treatment of the three grades of vomiting will be considered separately.

Physiological Vomiting.—By this term is meant the degree of nausea and sick stomach that is seen in the majority of pregnant women. The physician will not often be consulted about it. The woman expects it, and knows that it will soon pass away. When asked for a remedy, I give 10 grains of bromide of sodium in a table-spoonful of camphor-water as a routine practice. This, with certain hygienic suggestions to be referred to later, is usually sufficient.

Exaggerated Vomiting.—The treatment of the exaggerated vomiting of pregnancy is such a complicated subject that it is advisable to consider it under the separate headings, hygienic, medicinal, gynæcological, and obstetrical.

Hygienic Treatment.—This includes regulation of the diet. A very important item in this connection is the administration of food before the patient rises from bed in the morning. A light breakfast of tea and toast or a little milk and crackers as soon as she awakens, and while she lies flat upon her back in bed, will often prevent the early-morning nausea and vomiting, which are apt to be worse then than at any other time in the day. An essential matter demanding attention in many cases is the restriction—or, better, the prohibition—of sexual intercourse. In a large number of these cases all treatment will be neutralized unless husband and wife can be kept apart. It is often a delicate matter to attain one's object, and some diplomacy will usually be required. I have succeeded in curing the exaggerated vomiting of pregnancy by securing for the wife absence for some weeks from home on the plea that she needed change of air and scene, in a case that had resisted other plans of treatment, and that depended, I believe, on an abuse of the sexual relations which I was powerless to control.

In some aggravated cases it seems to be the act of swallowing which incites vomiting, so that feeding through an œsophageal tube or benumbing the sensibility of the fauces by a cocaine spray will enable the patient to ingest and to retain sufficient nutriment. If the stomach is so irritable that it retains nothing, throwing off even the mucus and digestive fluids in it when no food is eaten, rectal alimentation is the only resource to tide the woman over the period in which the vomiting is apt to be at its worst. In administering food by the rectum the following points should receive attention: The food should be concentrated, if possible predigested, given in as small quantities and repeated as infrequently as is compatible with sustenance of the woman's strength. Pancreatized milk and the various predigested preparations of beef and albuminoids upon the market should be used, and just before the nutritive enema is administered the bowel should be washed out with warm water. In this way the patient can be sustained for a surprising length of time, and the artificial interruption of pregnancy may be avoided. Dr. H. F. Campbell kept a patient alive in this manner for fifty-two days; but it must be remembered that while a woman's nutrition may be fairly well maintained by rectal alimentation, she may die from the exhaustion of the incessant action of the stomach with nothing to throw off but thin mucus and bile, as happened in a reported case. In rare cases tolerance on the part of the stomach may be secured by administering certain articles of food which the patient craves, but which appear to be entirely unsuitable for one in her condition.

Quite recently Kaltenbach has called attention to the true hysterical character of hyperemesis gravidarum in many cases. This fact had been publicly mentioned previously, however, and has long been known, doubtless, by many clinical observers. On one occasion I cured a desperate case of hyperemesis simply by making a vaginal examination. I was a stranger to the patient, called in consultation. The nervous impression made upon the woman by the examination cured her at once. She did not vomit again and went to term. This is the secret of the apparent success of many plans of treatment much vaunted in obstetrical literature. For example, some time ago I gave a hypodermic injection of hydrobromate of hyoscine for excessive vomiting, with immediate and lasting good effect. I thought I had discovered a valuable treatment for the hyperemesis of pregnant women, but in the next case I failed completely, and was obliged to induce abortion.

Medicinal Treatment.—Almost all the drugs in the Pharmacopœia have been extravagantly praised at some time or another as specifics in the vomiting of pregnancy. Prominent among them for the number of successful results obtained are wine of ipecac, tincture of iodine, 1 to 2, in water; oxalate of cerium; subnitrate of bismuth; tincture of nux

vomica; antipyrine; menthol; hydrobromate of hyoscine; ingluvin; and cocaine. The general nervous sedatives are, in my opinion, the most reliable. In bad cases chloral, with bromide of sodium given cautiously by the bowel, and possibly hypodermics of morphine (although in some cases a source of aggravated vomiting), will answer as well as anything. Too much time may be lost in experimenting with many drugs for in true uncontrollable vomiting they may all fail, and the opportunity for safely inducing abortion, and thus saving the woman's life, may be lost.

Gynæcological Treatment.—Whenever a case of hyperemesis does not yield to simple medicinal treatment and to hygienic management, a vaginal examination should be insisted upon, for the cause of the vomiting can thus frequently be detected and removed. A displaced uterus should be replaced. If the cervix is inflamed and eroded, applications of silver-nitrate solution or of peroxide of hydrogen, in the manner already described, should be tried. If pregnancy is complicated by a chronic metritis, glycerin tampons may be employed. If there are periuterine adhesions, these may possibly be stretched or broken, though the remedy might prove more dangerous than the disease. Empirically, a 15 per cent. solution of cocaine wiped over the vaginal vault through a speculum has cured, and may again cure, the vomiting.

The so-called Copeman method has many advocates. It consists in dilating the cervical canal with the forefinger or with special instruments devised by Gill Wylie and others, and extravagant claims have been made for it; but in my own experience it has failed much more often than it has succeeded, so that personally I have little confidence in it.

Obstetrical Treatment.—This is the induction of abortion. It is the treatment for true uncontrollable vomiting in pregnancy which has refused to yield to all other treatment. It is always difficult to decide when it has become necessary. I am governed by the following considerations in arriving at this decision: If the patient has been nourished entirely by the rectum for a week or ten days without cessation of the vomiting; if the pulse is much over 100; if the physical exhaustion is great,—I hesitate no longer. Each case, however, must be judged on its own merits. On one point I am clear: if mistakes must once in a while be made—and they are inevitable in a situation involved in so much doubt and obscurity as to the outcome—I would rather, occasionally, unnecessarily sacrifice an embryo than occasionally lose both woman and fœtus by too great delay. The mortality of pernicious vomiting is high. The disease is dangerous. Of 239 cases, 95 died; of 57 cases treated by ordinary methods, 28 died; of 36 cases treated by the induction of abortion, 9 died.

Intestines.—Constipation has already been referred to, and needs no further mention. Diarrhœa may complicate pregnancy; if so, it is treated usually by the ordinary methods. It should be mentioned, however, that there is a diarrhœa of pregnancy, dependent upon the increased nervous irritability of the intestines, which can better be controlled by the nerve-sedatives, bromides and chloral, than by intestinal astringents.

Gastric and intestinal dyspepsias are quite common in pregnancy. The latter may give rise to sharp and severe abdominal pains that resemble somewhat those of extra-uterine pregnancy. They yield usually to capsules of bismuth, pepsin, and charcoal, and the bromides in solution.

Liver.—Jaundice is frequently seen during gestation as a result of a mild catarrhal condition of the bile-ducts which may have existed before pregnancy, but which is ordinarily aggravated by it. Regulation of the diet and bowels is usually sufficient in the way of treatment. A much more serious complication of pregnancy is the rapidly-progressing, degenerative disease of the liver that sometimes follows the circulation in the blood of virulent poisons, probably leucomaïnes, the result of active tissue-change in the fœtus and imperfect elimination on the part of the mother.

The only treatment is preventive—to provide for thorough elimination of waste products by the kidneys, bowels, and skin, after the plan to be described under the heading of Eclampsia.

Hæmorrhoids are always aggravated by pregnancy, and often develop in consequence of the interference with the pelvic circulation on the part of the growing womb.

The treatment should be medicinal and palliative purely. Operative interference might interrupt pregnancy, would be complicated by excessive vascularity, and would be demonstrated, after delivery, to be, very likely, unnecessary by the spontaneous subsidence of the hæmorrhoids.

The Kidneys.—It is unnecessary here to enter into an explanation of the kidney of pregnancy and of the various inflammatory diseases of the organ which may appear during gestation, and are more likely to be developed in that condition than in the non-gravid state.

The treatment of most kidney affections in pregnancy is practically the same, no matter what the exact nature of the disease may be, whether the kidney of pregnancy, interstitial or parenchymatous nephritis. What the obstetrician must fear in each of these conditions is kidney insufficiency, and to the prevention of this impending accident his attention is mainly directed. Kidney diseases which threaten a functional insufficiency of the organs manifest themselves in about 84 per cent. of cases by a symptom common to them all—

albuminuria. This is noted in about 6 per cent. of all pregnant women. There may be later, in addition, if the case progresses unfavorably, dropsy and other signs of insufficient kidney action.

A large majority of the cases of albuminuria in pregnancy are easily held in check or are much improved by treatment: the gestation continues uninterrupted, the labor is uneventful, and the albumin disappears from the urine shortly after delivery. This is the usual, but by no means the invariable, course of such cases. It often happens, therefore, that a practitioner who has not had a very large experience in obstetrical work sees in succession a number of cases of a mild type amenable to treatment, and acquires by this experience a fatal confidence in his ability to manage all cases of the kind successfully. For instance, on three occasions in the past twelve months I have heard physicians assert that they had never seen albuminuria in pregnancy end disastrously, and on this ground strenuously oppose the induction of premature labor, which was plainly indicated. As individual cases of this kind call often for different plans of treatment, and as it is impossible to lay down dogmatic rules to be followed in the treatment of every case, by a brief description of typical cases I can best, I think, indicate my views in regard to the treatment of albuminuria in pregnancy and the symptoms which demand the termination of gestation:

Case I.—Mrs. M——, a lady living in the country, over thirty years of age, who had borne four children without difficulty, and had always been in perfect health, in the sixth month of pregnancy suddenly noticed an almost complete suppression of urine, with œdema of the lower limbs and face. The family physician found the urine nearly solid with albumin, but could discover no casts. The patient was put on a milk diet, varied with vegetable soups and a few light vegetables. Medical diuretics, laxatives, and large draughts of water were ordered, but confinement to bed was not recommended. When I saw her first the treatment had apparently been followed by a great amelioration of her condition. The urine had very much increased in quantity, the albumin was less in amount, and the œdema had diminished. An examination of the urine by an expert revealed, however, one or two casts. The treatment was continued for two weeks longer, when I was again summoned. The condition was not quite so good as it had been on my first visit: the œdema was again increasing, and there appeared to be hydramnios, but a satisfactory amount of urine was passed; there were no head symptoms, and an examination of the eye-ground showed no sign of uræmic disease. There were, however, more casts to be found in the urine. The patient was extremely averse to the sacrifice of the fœtus by the termination of pregnancy, which was mentioned as a possibility, and I was not clear that this had become

a necessity, so I advised confinement to bed, diaphoresis, laxatives, and diuretics, a restricted diet as before, with the understanding that it might become necessary to interrupt gestation at any time, and that, at the best, it should not go beyond the eighth month. A few days afterward, very fortunately, labor came on without interference and a dead fœtus was expelled. The mother developed severe septicæmia, and in addition grave uræmic symptoms appeared. She narrowly escaped death; finally, however, recovered, but still has symptoms of true nephritis. This case well illustrates the difficulty of deciding when to interfere. I made the mistake, which is commonly made, of waiting till the last possible moment. It was by mere chance that this mistake was not attended by fatal consequences.

I could cite other more disastrous cases from former years to support this position, but it is unnecessary, for I believe that all who have had much experience of this kind will agree with me. I would not be understood to advocate the indiscriminate interruption of pregnancy on account of albuminuria. It must be remembered that in the majority of cases the question never arises at all. But in any case in which I was in serious doubt as to the course to pursue I would always decide in favor of terminating pregnancy.

Case II.—The second case was in the person of a physician's wife. It was studied with unusual care, and therefore was of more than common interest. Moreover, it stands as a perfect type of cases which admit of no doubt as to the necessary course to pursue. The patient was a primigravida. She had been in good condition till within three weeks of the sixth month, when œdema of the feet and face appeared. By careful daily examinations a slight trace of albumin could be discovered, but the quantity was so small than an expert in urinalysis doubted its presence. Repeated examinations for casts were made with negative results. The diet was restricted, large draughts of water were recommended, laxatives were given when required, and hygienic precautions were insisted upon. The condition remained in *statu quo* for more than two weeks, when suddenly, within twenty-four hours, the urine became very albuminous and the œdema increased, but still no casts were to be found. The patient was then put to bed, the diet was reduced to milk, and hot-air baths were administered. All the symptoms, however, grew rapidly worse in spite of treatment. By the fifth day the urine solidified on the application of heat and acid, and casts were found in abundance. It was then determined, in consultation, to induce labor without delay. A bougie was introduced, and about twenty-four hours later the delivery of a living fœtus was completed without accident. The infant died shortly after birth. There follows a daily record of the condition of the urine after labor:

Date.	Oz. in 24 hours.	Sp. gr.	Quantity of albumin estimated by Esbach's tube.	Date.	Oz. in 24 hours.	Sp. gr.	Quantity of albumin estimated by Esbach's tube.
Dec. 2	29½	1031½	6 gr.—litre.	Dec. 11	28½	1020	at 1
3	21½	1035	Above U.	12	31	1020	" 1
4	25	1032	" "	13	25½	1020	" 1
5	51½	1021	" 7	14	31½	1015	" ½
6	25	1037	at 4	15	40½	1015	" ½
7	33	1022	" 5	16	31	1021	" ¼
8	18½	1030	" 3¾	17	38	1015	" ¼
9	41½	1022	" 3	18	43	1016	" ¼
10	41	1017	" 1½				

From this date the albumin has slowly decreased until the present time, when it is but the merest trace, giving rise to a faint cloudiness, with heat and acetic acid. During the continuance of the treatment, until about a month after delivery, diuretics were administered. The remedies employed at different times were digitalis and acetate of potassium, caffeine, and Basham's mixture. On January 5 the diet was increased a little. Ten days later full diet was allowed. There is no doubt that pregnancy could not have continued in this case, and that the mother was rescued from an imminent danger by the termination of gestation. It is highly probable that in the future she may bear a living child without difficulty or danger.

Case III.—This case was that of a young woman illegitimately pregnant for the first time. On admission to the Maternity Hospital between the seventh and eighth months of gestation, there was considerable œdema of the lower extremities and face and the urine was albuminous to the extent of about one-eighth by bulk. The patient was put upon a restricted diet, meat being allowed but once in two days, and she was ordered two hot baths a week. No medicines were given at all, except a laxative when required. She had been taking, before admission, four or five different remedies. Under this simple treatment the albumin and œdema entirely disappeared within two weeks. The girl gave the interesting history that her father and grandfather had died of Bright's disease, showing, perhaps, an hereditary influence from the paternal side of the house, as Elliot's case, in which a mother and four daughters all had eclampsia, and Fauer's case, in which a mother and two daughters had convulsions in labor, show the transmission of a tendency to kidney insufficiency from the mother. At the expiration of four weeks, the patient then being under the charge of a colleague, a trace of albumin reappeared in the urine. A week later it had decidedly increased, and at the end of another week the increase was rapid and a large number of casts could be found. As the girl was only ten days short of term, labor was induced without hesitation. A bougie was inserted, and after eighteen hours a second was placed alongside the first. Thirteen hours later the child was

born. Two weeks later, by the ring test with nitric acid, no albumin could be found. The child, although mature, was wretchedly developed and died a week after birth.

If the woman can be saved any material danger by the induction of labor when almost at term, hesitation appears to me foolish. In this case contrast the woman's condition two weeks after her delivery with what it very likely would have been had pregnancy continued.

Although these selected cases required the interruption of pregnancy—a possibility always to be kept in mind—they permit of the description of the routine treatment of albuminuria in pregnancy, varied to suit individual requirements—a treatment followed by good results in the majority of instances, and carrying the patient along, if not to term, at least to a period in pregnancy when the birth of a viable child can be secured.

The principles of treatment, it may be observed, are the restriction of drugs as much as possible and close attention to hygienic management. If I were restricted to one medicinal preparation, I think I should choose Basham's mixture, in dessert-spoonful doses four or five times a day. No drug, however, is a specific, although one hears this claim advanced sometimes for certain remedies. Benzoic acid has been enthusiastically recommended, but I have not been able to see that it was pre-eminently superior to other diuretics.

The other renal diseases which might complicate pregnancy—namely, tumors, dislocation, pyelitis, hydronephrosis, and stone—require the same treatment as under ordinary circumstances, and do not therefore demand attention here.

Bladder.—The most common of the bladder disturbances during pregnancy is an increased irritability. This cannot always be controlled by medication, and is, in fact, usually not so exaggerated as to demand treatment. If it becomes so, however, nerve-sedatives are indicated. A vaginal examination should always be made to detect a possible displacement of the uterus.

Incontinence of urine in the pregnant woman should always arouse the suspicion of retention, which should be looked for. If the incontinence of urine is due to relaxation of the vesical sphincter, strychnine will accomplish as much as any medicine can do. If the incontinence is due, as sometimes happens, to extreme irritability of the bladder, the walls of which contract spasmodically as soon as any appreciable amount of urine collects, unirritating diuretics and nerve-sedatives are called for.

Bleeding varices of the bladder, a rare complication of pregnancy, may require the injection of solutions of tannic acid into the bladder, the internal administration of gallic acid, and the elevation of the pelvis. If this treatment fails, digitalis may succeed by overcoming the stagnation of the circulation and relieving the engorgement of the ves-

sels. Usually the bleeding, although alarming to the patient perhaps, is not enough to call for interference.

The treatment of cystitis in the childbearing woman will be considered elsewhere.

The other vesical diseases—calculi, cystocele, injuries, tumors, extrophy, etc.—are sometimes accidental complications of pregnancy. Their medicinal treatment does not differ in pregnancy from that in the non-pregnant female.

URINE.—Albuminuria has already been referred to. Polyuria to a marked extent is an exaggeration of the physiological alteration in the quantity and specific gravity of the urine during pregnancy. Voituriez[1] reports a case in which the woman urinated every hour, and passed 3200, 3500, and 4000 c.c. in the twenty-four hours. Twenty-four hours after delivery the quantity sank to normal. There was no sugar, no pus, albumen, or casts. Treatment was of no avail. Indeed, one would be very cautious about reducing the quantity of urine in a pregnant woman.

The lipuria, chyluria, peptonuria, and glycosuria of pregnancy require no treatment. The treatment of hæmaturia has already been described.

Diseases of the Nervous System.—The inflammatory diseases of the brain and spinal cord are accidential complications of pregnancy, and will not be considered.

The most important disease of the peripheral nerves is neuralgia, which may be of the most distressing and obstinate character if it depends, as is not uncommon, upon the existence of gestation. All the treatments for neuralgia may fail entirely, and a cure only be effected after delivery.

NEUROSES.—The chorea of pregnancy is the most important disease under this head. There are two distinct varieties—the mild and the malignant. The former usually yields to Fowler's solution, iron, and a generous diet, with good hygienic surroundings and possibly change of climate. The latter class of cases may obstinately resist treatment, and may require the induction of labor. This should not be delayed too long, for the disease in this form is dangerous, the mortality being about 33 per cent. An anæsthetic may be required to control the violence of the movements during labor.

Epilepsy and hysteria in pregnancy are to be treated in the same manner as in the non-pregnant female.

PSYCHICAL ALTERATIONS.—The insanities of the childbearing period are not amenable to medicinal treatment. Various complications arising from time to time require medicaments as in other insanities. One indication, however, I have found almost always in

[1] *Archives de Tocol.*, 1890, p. 852.

the insanities of childbearing women: they are almost invariably anæmic, and I have seen the improvement of the brain progress *pari passu* with the improvement of the blood.

Circulatory Apparatus.—The treatment of the valvular diseases of the heart in pregnancy is the same as under ordinary circumstances, although there are special complications and aggravations to be dealt with, very likely due to the disturbances in the circulation caused by the uterine tumor. The chief danger in heart disease complicating the childbearing process is at the conclusion of the second stage of labor. The uterus is suddenly emptied of its contents, the muscle contracts, the intra-abdominal pressure is much lowered, and the large quantity of blood theretofore carried to the womb is determined to other quarters. It is at this time that the heart is engorged, embarrassed, and possibly paralyzed. To avoid this danger the physician should favor bleeding from the womb, and in case this fails should be ready for immediate phlebotomy. It is a wise precaution, too, to have nitrite of amyl at hand, for the inhalation of this drug has produced brilliant results in threatened heart failure during labor. Directly after the expulsion of the child it is also of advantage to apply an abdominal binder and pad to neutralize somewhat the sudden change in intra-abdominal pressure. With these precautions, and by supporting the heart with digitalis during the first stage of labor, and using the forceps in the second stage, it is astonishing how bad a case of valvular heart can be conducted safely through labor. I have thus delivered without accident a woman who had had orthopnœa for weeks beforehand, and was deeply cyanotic. Do what one will, however, the death-rate of labor complicated by advanced valvular disease of the heart is high. It is said that about half the cases die, but my own experience in a number of bad cases would lead me to take a somewhat more hopeful view than this.

The coexistence of pregnancy and diseases of the heart-muscle, Graves' disease, and goitre, leucocythæmia, diseases of the blood-vessels and alterations of the blood, does not materially alter the therapeusis of these diseases. In the last named, however, it should be remembered that an anæmia so profound as to appear pernicious may arise in pregnancy and in the puerperium, but may yield promptly to iron and arsenic and good hygiene.

Respiratory Apparatus.—The diseases of the respiratory tract demand the same treatment in pregnancy as otherwise. In etiology and influence upon, and as influenced by, pregnancy many interesting questions are to be considered, but these are out of place here. One peculiar symptom in the pregnant woman, however, deserves special attention. Hæmoptysis may occur in the latter months of pregnancy quite independent of actual disease of the lungs. It is due to a "car-

diac nerve-storm" to which pregnant women are liable. I remember seeing a patient toward the end of pregnancy lying in bed with brightly suffused cheeks, shining eyes, and rapid pulse, with every appearance of fever, but with a normal temperature. Occasionally she would expectorate bloodstained mucus. The heart beat so violently as to raise the præcordium very perceptibly. After trying aconite for some hours without success, bromide of sodium and chloral were administered, with almost immediate good result.

The infectious fevers and diseases, injuries, and accidents, and skin diseases, are passed by with mere mention. There is nothing peculiar in their treatment during pregnancy.

Abortion.

If a pregnant woman presents any of the conditions which a physician's experience or knowledge teaches him may lead to the premature interruption of pregnancy, the treatment of these conditions will constitute the preventive treatment of abortion. The proper conduct to pursue in such cases may be briefly indicated as follows:

In cases of irritable uterus the woman must be jealously guarded against any nervous shock, undue physical exertion, errors in diet, sexual intercourse—anything, in short, that would furnish the uterus an excuse for throwing off its contents. In exaggerated cases of this condition prolonged rest in bed, especially at the time corresponding to the menstrual periods, or perhaps for the whole duration of pregnancy, may be necessary to secure the birth of a mature infant. If the pregnant uterus is displaced downward or backward, it must be restored to its proper position, and be kept in place by a suitable pessary until its increasing size prevents it from again descending or falling backward. If there should be uncontrollable vomiting or coughing, these conditions must be treated according to well-known principles. Asthma, which in some cases will determine a premature interruption of pregnancy, is best treated by change of climate.[1] In general muscular spasms, as in eclampsia, cholæmia, chorea, epilepsy, hysteria, and tetany, the convulsions must be combated by appropriate remedies. The infectious and febrile diseases of pregnancy must be managed on general principles, without special regard to the danger of abortion, which is often unavoidable. Chronic metritis and endometritis, fibro-myomata of the uterus, lacerated cervix, perimetritis and cellulitis, disease of a tube or an ovary, must be treated before impregnation occurs. If, however, in spite of every precaution, the signs of threatened abortion manifest themselves, the treatment resolves itself into—(1) the treatment of threatened abortion, (2) the treatment (if necessary) of inevitable abortion, and (3) the treatment of the woman *post-abortum*.

[1] See note by Harris to Playfair's *Midwifery*, p. 243.

The Treatment of Threatened Abortion.—The two main principles of the treatment adopted to avert a threatened abortion should be perfect rest and the administration of drugs that will diminish nervous sensibility and weaken muscular action. The first can only be secured in bed in a perfectly supine position; the room should be darkened and kept quiet, that the rest may be mental as well as physical. The second object of the treatment can be accomplished by giving opium, bromide of potassium, and chloral. Opium enjoys a well-deserved reputation in these cases; many instances may be cited of its beneficent working. It may be administered by the mouth as laudanum, hypodermically as morphine, or by the rectum: it seems to be the custom in France to inject laudanum into the rectum—a clumsy method of accomplishing what is better effected by our suppositories. Women on the verge of abortion display usually a remarkable tolerance of opium, and to be effective the dose must often be large: as much as a drachm or more of laudanum has been given within twenty-four hours without ill effect, but of course the patient must in such cases be carefully observed. With the opium it is often of advantage to combine moderate doses of chloral and bromide of potassium. Viburnum prunifolium[1] has of late years been much vaunted as almost a specific in the prevention of abortion, and its use has become very general throughout this country. The verdict in regard to this drug is, on the whole, favorable: Lusk speaks well of it; in England it has been tried by Campbell[2] and Napier,[3] who both recommend it; and its employment seems to have spread even to Russia.[4] It may be given, in the form of a fluid extract, in tea-spoonful doses.

Treatment of Inevitable Abortion.—As soon as all hope of arresting a threatened abortion is destroyed by the appearance of signs pointing to the unavoidable expulsion of the uterine contents, the treatment must be radically altered. Absolute rest is no longer necessary, although the patient must be confined to bed, while the administration of drugs that diminish sensibility and weaken muscular action is positively harmful, for it prolongs a process which in the interests of the patient were best completed as speedily as possible. But in many cases the woman will linger on, perhaps for days, before the greater part of the uterine contents is expelled, and it may be weeks before she is rid of the thickened decidua, which usually remains behind, or of the adherent placenta, which is often retained in the uterus after the escape of the embryo and the rest of the ovum; and all this time there may be recurring hæmorrhages of an alarming character or a constant dribbling of blood, and the lochial discharge

[1] Jenks: "Viburnum Prunifolium," *Tr. Am. Gyn. Soc.*, vol. i. p. 130.

[2] *Br. Med. Journ.*, 1886, i. p. 391.

[3] *Ibid.*, p. 489.

[4] Reference in *Index Med.*, 1887, Lvov.

becomes abundant and is perhaps ill-smelling. Now, in such a case the question naturally arises as to the advisability of interference, either early in the progress of the case, in order to bring it to a speedy termination and to clear the uterine cavity thoroughly of substances that might give rise to future trouble, or at least when the hæmorrhages become alarming and the discharges offensive. This question receives different answers from authorities equally entitled to respectful attention.

If the hæmorrhage is severe before the os is at all dilated or any portion of the ovum discharged, there is no difference of opinion as to the necessity of controlling the bleeding. This is best effected by a vaginal tampon of baked cotton[1] made up into balls about the size of a walnut, packed closely in the vaginal vault and in front of the cervix until the vagina is filled in its upper third. A Sims speculum will facilitate the introduction of the tampons. Braun's colpeurynter, which is recommended so highly by its inventor for this purpose, has not, and probably will not, find general acceptance. If the woman is so anæmic that the loss of even a small quantity of blood is of moment, it would often be of advantage to tampon the cervical canal, or, better still, the whole uterine cavity, employing for this purpose either little balls of iodoformed cotton, as Vulliet advises, or strips of iodoform gauze, as Dührssen[2] does in these cases. Vulliet's method has done me good service in controlling severe hæmorrhages from the body of the uterus in cancerous disease of that organ, and would probably be found very useful in the excessive hæmorrhage of abortions, especially in the early months of pregnancy. The vaginal tampon should be removed after six or eight hours, and replaced by a fresh one if necessary, but often, as the first one is removed, along with it will come the ovum or fœtus, and the immediate symptoms may in great part subside. But the uterus may not yet be empty: in the early months the large mass of deciduous membrane has almost certainly remained behind in the uterine cavity; later the placenta will frequently be retained. Here it is that there is so much difference of opinion as to the proper course to pursue. Whether now to treat the case expectantly until serious symptoms develop, or to remove at once the substances in the uterus which may give rise to future complications, is a problem that must frequently confront every practitioner. In France the more conservative course is almost universally adopted. Tarnier quite recently speaks strongly in favor of avoiding any interference even if the whole placenta is

[1] Cotton baked in an oven till it becomes a little singed and well sterilized. The use of antiseptic cotton is scarcely advisable, for the quantity required for an efficient tampon is so large that the danger from absorption of the germicide with which it is impregnated cannot be overlooked.

[2] *Loc. cit.*

known to be in the uterus: he insists that the uterus should be allowed time to expel the foreign substance in the course of nature, but that in the mean time antiseptic injections should be systematically employed: if, however, alarming hæmorrhage appears or the discharge becomes foul, more active measures are counselled. Tarnier points to the statistics of the Charité and the Maternité, in which he saw 46 cases of retained placentæ after abortion, with only 1 death, and that from pneumonia; but by the statistics of the hospital in Florence already referred to, in which pretty much the same plan seems to be pursued as that advocated by Tarnier, the death-rate after abortion is 6 per cent. Guéniot was for some time the only prominent dissenter from the general practice in France, but recently he has been joined by Doléris,[1] who recommends active interference in retention of the placenta, but counsels a conservative course when the membranes are retained. In Germany the same difference of opinion may be met with in regard to the treatment of inevitable abortion, but the majority lean to the more active course. Schroeder[2] says that although the abortion must not be hastened until there is some dilatation of the os and until the ovum is pretty well separated from the uterus, then the uterine contents can often, in the early months at least, be pressed out by Hoening's method, squeezing the uterus between two fingers in the vaginal vault and those of the other hand on the abdomen. If any portion of the ovum should remain behind, it must, says this author, be invariably removed, even should the cervix have to be split on both sides to reach it. If the retained substance is the hypertrophied decidua of early pregnancy, Schroeder advises the use of the sharp curette to remove it. Fehling[3] and Schwartz[4] are also warm advocates of an active treatment. Braun[5] rather deprecates the employment of instruments in these cases, but advises the use of the finger, whenever possible, to remove the ovum. Dohrn,[6] on the other hand, carries the expectant plan of treatment to its farthest limits, and Winckel attempts no active interference.[7]

In this country the views of Mundé are well known. "The future safety of the patient," says this authority, "demands that the secundines should be at once removed after the expulsion of the fœtus in every case in which such removals can be accomplished without force sufficient to injure the woman." Parvin, whose opinion must always command respect, recommends, on the other hand, non-interference with

[1] *Nouvelles Archives d'Obstet.*, 1886, p. 318.
[2] *Geburtshülfe*, S. 482.
[3] *Archiv f. Gyn.*, Bd. xiii. S. 222.
[4] *Samml. klinischer Vorträge.*
[5] *Lehrb. der Gesammt. Gynäk.*, 2te Aufl. S. 614.
[6] *Samml. klin. Vortr.*, 42.
[7] Practice observed by the writer while volunteer interne in the Frauenklinik at Munich.

the cavity of the uterus in abortion unless at some later period hæmorrhages occur or septicæmia is threatened.

Now, in determining this question in regard to the treatment of inevitable abortion, an answer to the following questions is desirable: Is the retention of decidua, fœtal membranes, or placenta after abortion fraught with any danger to a woman? and, Is the immediate removal of the secundines after abortion necessarily a violent or dangerous procedure? Cases are reported, it is true, in which the retention of the placenta was followed by no immediate symptoms; but will any one say that under such circumstances a woman is healthy and free from danger? The following case, abstracted from Tarnier and Cazeaux, is instructive in this connection, for Tarnier, be it recollected, is one of the foremost advocates of the expectant treatment—the italics in the quotation are mine: "During the first five days the patient did very well, but on the sixth *I thought I detected a slight odor in the lochia*, and at three o'clock in the afternoon a violent chill came on which lasted an hour. . . . . This unfortunate lady died on the tenth day. At the post-mortem examination we found the uterine tissue softened and *its cavity filled by the putrefied and still adherent placenta.*" Note that on the sixth day there was a mere suspicion of a putrid odor to the discharge, and yet at that very time the woman was probably doomed.

The question as to the danger of active interference after abortion can only be answered by those who have adopted this plan of treatment in a skilful and judicious manner. Dührssen[1] has lately reported 150 cases of abortion treated by a thorough and immediate clearing out of the uterine cavity, with only 2 deaths, and these in no manner attributable to the treatment adopted. I have used the curette and the placental forceps to reinforce the finger in a large number of cases, and have never seen the slightest ill effects from them; on the contrary, the treatment proved invariably beneficial. It must be acknowledged, however, that in the hands of general practitioners, unaccustomed to gynæcological manœuvres, the curette in the puerperal uterus may prove a dangerous instrument. A most distressing case has recently occurred in Berlin,[2] where a practitioner caused the death of a patient by perforating her uterus with a curette after an abortion, in consequence of which the physician was sentenced to imprisonment. There will be many, therefore, who will be indisposed to resort to instrumental interference after abortion; and, moreover, in a choice of the treatment to be adopted much depends upon the temperament of the physician as well as upon the circumstances of the case. Consequently, in a work of this kind it is fairer to give a sketch of both plans of treatment.

[1] *Loc. cit.*

[2] *Deutsche med. Wochenschr.*, 1886, 28, xv.

Expectant Treatment.—When an abortion becomes inevitable, ergot may be substituted for the drugs that have been employed to inhibit muscular action: if there is much bleeding, tampons are to be used in the manner already indicated, and removed from time to time until the ovum is expelled or else so well separated from the uterine wall that it may be gently expressed or easily extracted by the fingers. The greatest care must be exercised to avoid rupture of the membranes, for this will probably lead to the retention of a portion of the ovum, while the expulsion of the ovum *en bloc* is particularly desirable in cases managed after this fashion. If a part of the embryo or its appendages should remain behind in the uterus, the woman is to be kept quiet in bed, small doses of ergot are to be administered, and the vagina and, if possible, the uterine cavity are to be kept aseptic by injections of some effective germicide, preferably bichloride of mercury. The folly of neglecting this precaution until the substance *in utero* begins to putrefy is shown by the cases already quoted. If, in spite of all precaution, the discharge becomes foul or if hæmorrhages occur, all are now agreed that the uterine cavity is to be cleared out. The manner of doing this will be indicated later.

Active Treatment.—The first step of this plan of treatment resembles that already described. The tampon is used to control bleeding, and as soon as the dilatation of the os is sufficiently advanced to admit a finger efforts are made, in early abortions, to turn out the ovum by sweeping the fingers around it, and then extracting it, with the finger crooked behind it like a hook; or Hoening's method of expression may be tried. The proposition of Dührssen to treat the ovum before the third month like a polypoid tumor, and as soon as the os is slightly dilated to introduce a curette and incontinently clear out the uterine contents, is, to the writer's mind, not a bad one. The ovum being wholly or in part expelled, everything left behind in the uterine cavity, whether thickened decidua or placental tissue, is to be extracted. Various means have been proposed for accomplishing this purpose. For an adherent placenta nothing is better, in the writer's opinion, than the finger, which can be made to reach the fundus, the patient being anæsthetized if necessary, by pressing the uterus down from above through the abdominal walls. By the finger the placenta is peeled off from the uterine wall and afterward easily extracted. Often so much force is necessary to do this that the use of an unyielding and insensible instrument is not advisable. To clear out the thickened decidua, which almost invariably remains behind in early abortions, nothing is so good as a curette, of which many varieties have been proposed for this purpose. Mundé's instrument demands a widely-opened os, and is more effective as an extractor of substances loose within the uterus than as an instrument designed to separate

membrane or placenta adherent to the uterine wall. Simon's spoon has been very satisfactory to me when the os is small and the uterine cavity is not too large. For the uterus *post-partum* or after miscarriages I have an instrument somewhat resembling Mundé's in shape, but with a distinctly scraping edge. Dührssen has demonstrated that the decidua removed from the uterus in this manner is not rudely torn off, but is separated in a natural manner in the cellular layer. If the os is so retracted that neither a finger nor an instrument can be introduced, the introduction of Hegar's graduated hard-rubber cervical dilators will obviate the difficulty. A placental forceps is almost always a necessary adjunct to the finger and the curette. With the three the uterine cavity can be thoroughly cleansed. Without one or the other this is not likely to be effected.

After the uterine cavity is cleared out it should be disinfected by a gentle stream of antiseptic solution introduced preferably through a Bozeman's or a Lentz's catheter.

The After-treatment of Abortion.—If an active treatment has been pursued, the after-treatment will be very simple, for the lochial discharge in these cases is slight and the involution of the uterus rapid. Until this latter condition is perfected the woman, of course, should be confined to bed. The after-treatment when an expectant plan has been pursued has already been indicated. Should septicæmia develop, it is to be managed on the same principles that govern the treatment of this condition after delivery at term.

Extra-uterine Pregnancy.

Under this head there is nothing of positive value to be said. The only two medicinal plans (as opposed to surgical) of treating extra-uterine pregnancy are the application of electricity and the injection into the gestation sac of morphine. Although the first is still highly lauded in some quarters, it will soon take a place among the historical curiosities of therapeutics which have had their day and have been abandoned. I have seen the strongest electrical currents, 100 milliampères of galvanism and as strong a faradic current as possible, applied to the gestation sac daily for a week at the sixth week of pregnancy, and yet the embryo continued to grow for seven weeks afterward. It is not strange, therefore, that I deny the power of electricity to destroy an embryo. The cases in which this agent seemed to effect a cure are explicable by the fact, demonstrated by Schauta's statistics, that about one-third of all diagnosticated cases of extra-uterine pregnancy end in spontaneous recovery by the death of the embryo or fœtus.

The injection of morphine, first proposed by Joulin, first applied by Friedreich, and recommended at present by Winckel, is acknowledged to be not always successful in destroying the fœtus and has had a mor-

tality in 11 cases of 27 per cent. It is not therefore to be compared with the surgical treatment, and should only be adopted by one who is incompetent to do skilful abdominal surgery, and whose patient cannot be put in the surgeon's hands.

Labor.

The administration of drugs forms such a small part in the treatment of the complications of labor that it will be given little more than mere mention.

The most common indication for medical treatment is furnished by those cases of delayed labor in which a too firmly resisting cervix offers opposition to dilatation and descent. In such women, usually primiparæ, the administration of chloral in two doses, 20 grains each, an hour apart, will very likely do good. It is a wise plan in obstinate cases to reinforce the action of the chloral by warm-water injections against the unyielding cervix. Chloral is also administered in cases of hysterical excitement during labor, which, if not controlled, might develop into mania. The use of quinine to goad on a flagging uterus has already been noticed. I have no faith in it, and no longer use it. Instead, I am in the habit of prescribing a glass of sherry with a little cracker or toast when the pains of the first stage weaken from fatigue, and again just before the onset of the second stage, so that the abdominal muscles may act with vigor.

It is necessary when labor is complicated by any disease, acute or chronic, much undermining the general strength, to resort to stimulants during the first stage, and to shorten the second stage with forceps, in order to avoid as far as possible the profound shock which the exercise of the parturient's force occasions. For example, in a case of labor occurring at the height of an attack of typhoid fever I have seen the temperature drop from 104° F. at the beginning of the process to 95° just after its conclusion.

In the many grave accidents of obstetric practice the patient must usually be treated for profound shock and the loss of blood. As the treatment is the same as it is for the same conditions in general surgery, it need not be described here.

PUERPERAL DISEASES.

The diseases of the puerperium may be divided into two broad classes—infectious and non-infectious. The first class should be further subdivided into (1) those infectious diseases in which the point of infection has been somewhere along the parturient tract, and

(2) those in which the infecting poison has entered the body by some other channel. Under subheading (1) come all those diseased conditions grouped together in the very inadequate generic terms "puerperal fever," "puerperal septicæmia," "puerperal infection," and the like, none of which truly expresses the condition. If it is necessary in medical nomenclature to have a single term which shall denote infection of the genitalia after delivery, a word should be coined strictly limited in sense to mean the pathological conditions which result from the activity of pathogenic microbes along the whole genital tract. This classification is necessary for a clear and systematic description of the treatment of diseases in the puerperal state.

The Treatment of Infection along the Genital Tract after Labor.—By far the most common form of infection along the genital tract after labor is the absorption of ptomaïnes from the infection and decomposition of membranes, fragments of placenta, or blood within the uterus. This condition will be found in more than 75 per cent. of all cases in which infection occurs at all. Therefore, in any case, after labor, in which there is fever that cannot be explained by some evident cause independent of the genitalia, it is safe to assume ptomaïne-poisoning and to act accordingly. The indications are plain: to destroy the microbes and thus at once stop the manufacture of their poisonous products, and, if necessary, to remove their habitat.

The writer's routine application of this principle in practice is as follows: If the temperature after delivery remains over 100° F. for twenty-four hours without evident cause independent of the genitalia, he washes out the uterine cavity with at least 1 quart either of bichloride-of-mercury solution, 1 : 2000, or a 2 per cent. solution of creolin. The former is more convenient in private practice, because the tablets of corrosive sublimate can be easily carried about in one's instrument-bag. To ensure the entrance of the antiseptic fluid to the fundus and its free exit from the cervical canal an intra-uterine catheter is desirable. Of all those upon the market, the best is that manufactured by Lentz, an instrument-maker of Philadelphia. If, however, the cervical canal is patulous, as it usually is after labor, a hard-rubber catheter attached to a Davidson's or fountain syringe answers the purpose perfectly.

In the majority of cases this treatment will bring the temperature down to normal within twenty-four hours. If fever does not disappear within this time, or even perhaps rises higher, the second indication must be met. The infected albuminous substance within the uterine cavity must be removed in order to deprive the micro-organisms of their feeding-ground. This is best accomplished by the use of the curette and the placental forceps, care being taken in the employment of the former instrument to guard the uterine wall itself from the

slightest injury, for not only can the uterine muscle be perforated by a curette in clumsy hands, but slight wounds of the uterine substance with this instrument may be enough to inoculate the general system with the germs whose activity had been confined before to the uterine cavity.

The writer's manner of employing this plan of treatment after labor is as follows:

The anterior lip of the cervix is seized with a double tenaculum and pulled gently downward; a cleansing uterine douche is then given in order to disinfect the field of operation; next the curette is inserted to the fundus, and the whole interior of the uterus is carefully gone over with the instrument—first the fundus and then each of the four sides; then the curette is turned with the scraping surface upward and withdrawn from the cervical canal, a finger in the vagina meeting its tip as it emerges in order to help extract any substance which may be caught by and entangled in it.

Next the placental forceps is inserted, and an effort made to grasp any material lying loose within the cavity or still attached to the uterine walls. It is usually best to repeat each of these manœuvres several times until nothing more can be brought away except a little clear blood.

Then the uterine cavity is again thoroughly washed out. The writer has many temperature charts in his possession which show the success of this treatment when simple uterine irrigation has failed. Occasionally it is necessary to repeat the irrigation, and even the curettement, for several successive days. If, as rarely happens, this treatment should prove unsuccessful and the temperature should remain elevated in spite of irrigation and the use of the curette and placental forceps, one must assume either that general systemic infection has occurred, or, at least, that an inflammatory action has begun in the uterine walls or within the tract of the tubes. One of the earliest, surest signs of systemic invasion is the appearance of peritonitis.

In such a case the only available treatment is to support the body-cells in the combat which they must wage with the invading micro-organisms. This is best accomplished by the administration of as large a quantity of nutriment as the patient can stand without rebellion of the stomach or bowels, and the exhibition of a large quantity of alcoholic stimulant. Cases of this sort not infrequently require more than a pint of whiskey or brandy in the twenty-four hours. Occasionally measures will be required to reduce an exaggerated elevation of the temperature, but this is best abstained from as long as possible, for antipyretic treatment is usually depressing and ill suited to the patient's adynamic condition.

With this plan of treatment about three-quarters of the cases of

general septic infection after labor will recover. There may be some in which metastasis occurs so early to important organs as to render all treatment of no avail. There will be others in which the peritoneum is early infected, and in which the septic peritonitis develops rapidly and to an extensive degree. It is in such cases that laparotomy and evacuation of the septic matter, usually pus, within the peritoneum will occasionally save life. The physician must guard himself, however, from the disposition which is prevalent at this day to operate too early and unnecessarily. After operation, drainage of the peritoneal cavity is an essential feature of the treatment, even although the evidence of suppuration within the cavity is slight. The writer has in mind a case in which an operation was performed ten days post-partum for septic peritonitis: a very small quantity of purulent lymph was found upon one ovary, which was greatly enlarged and contained a small quantity of sero-pus. The ovary was removed and the abdomen closed without drainage, as there was no other evidence of suppuration within it. Thirty-six hours later the patient died, and the peritoneal cavity was found filled with pus which had accumulated in that short space of time. In the early stages of the peritoneal infection, if the subject is vigorous, not exhausted by a prolonged labor or other depressing causes, the administration of saline purgatives in concentrated solution will often effect brilliant results.

The writer's system is to give a dessert-spoonful of the concentrated solution of Epsom salts every fifteen minutes until free evacuation of the bowels is secured. He has seen the temperature reduced by this plan of treatment from 104° F. to normal in the course of twelve hours, and with the reduction of temperature all the symptoms of peritonitis, which were well marked, entirely disappeared. In the treatment of microbic activity along the parturient tract after labor it should never be forgotten that the point by which the microbes invade the system may be anywhere from the fundus of the uterus to the parturient outlet; therefore the practitioner should never neglect to examine carefully all the lower parturient tract, in order to detect, if possible, an ulcerated surface covered by diphtheritic membrane, which if overlooked might be the entrance-point for a fatal infection. These unhealthy surfaces are best detected by the use of a cylindrical speculum of clouded glass introduced so that the cervix appears within its inner end, and then withdrawn, when the vaginal mucous membrane as it prolapses into the end of the speculum may be examined, and treated if necessary throughout its whole extent. If an unhealthy ulcerated wound is thus discovered, the writer's practice is to apply to it a solution of nitrate of silver, 40 or 60 grains to the ounce. In the vast majority of cases this application will promote an exfoliation of

the unhealthy membrane and the appearance of healthy granulation tissue within a few days.

It may, in some cases, be necessary to employ a stronger application, as the solution of chloride of zinc, but the writer has not been driven to its use. The most common point of infection outside the parturient tract after labor is some portion of the urinary apparatus, almost invariably the bladder. The process of parturition necessarily diminishes the vitality of the vesical mucous membrane cells by the pressure and stretching to which they are subjected. After labor, therefore, they are not in a condition to resist the attacks of micro-organisms, should these in any way gain access to the vesical cavity. Most commonly microbes are introduced into the bladder by a catheter. This, however, is not necessary, as it has been plainly demonstrated that they can wander from the vaginal canal through the urethra into the bladder without the intervention of an instrument which directly carries them into the vesical cavity and deposits them in that situation. Once arrived within the bladder, the microbes attack the depressed bladder-cells, and very often gain a lodgment in the vesical mucous membrane. This is manifested by the usual symptoms of septic cystitis, fever, pus in the urine, pain on pressure over the hypogastrium, and pain and difficulty in micturition. The duration of these symptoms is, as a rule, not very long. The fever subsides and the symptoms of cystitis disappear. After an interval of some days, however, there is again a sharp outbreak of fever, with pain in the region of the kidneys, and the reappearance of pus or at least of numerous microbes in the urine. This indicates a septic infection of the pelves of the kidneys after the micro-organisms have migrated along the ureters. During their course upward their presence has not been manifested by any symptoms. In the majority of cases even the symptoms of pyelitis will disappear after a time, and the patient will make a good recovery; but in a certain proportion there is a systemic infection by the direct passage of microbes or their products from the kidneys into the blood. There may be an extensive suppuration of the kidneys and surrounding tissues, with fatal result, or, as the writer has seen in several cases, the symptoms of general systemic infection become so grave as for a long time to threaten the patient's life. In the worst cases of bladder infection the mucous lining sloughs, peritonitis develops, and the patient dies before the disease has time to spread to the kidneys.

The practitioner, bearing in mind the serious consequences of septic cystitis after labor, should always be on the watch for it, and should adopt, immediately upon its discovery, an energetic treatment. A thorough disinfection of the bladder will remove all present symptoms, and prevent the occurrence of grave and possibly fatal after-

complications. To accomplish this purpose the writer employs a ½ of 1 per cent. solution of creolin. One injection of a quart of this solution through a two-way catheter is usually sufficient. Occasionally it is necessary to repeat it, or to follow it by several injections of boric-acid solution. In susceptible individuals creolin causes too much pain to be employed. A 1 : 8000 bichloride-of-mercury solution may be substituted for it, or, in mild cases, a solution of boric acid alone will be sufficient.

If, in spite of all precautions, infection of the kidneys should ensue, a vigorously stimulating and supporting plan of treatment affords the only hope of success. If extensive suppuration occurs in the kidneys, all treatment will of course be useless.

Perhaps the most uncommon point of septic infection after labor is the rectum. The writer has, however, seen one fatal case of this sort, from the use, no doubt, of a dirty syringe-nozzle in the hands of a careless nurse. It would be difficult, or perhaps impossible, to diagnose such a case until after death, and therefore treatment directed toward this form of infection will usually not be adopted.

Next in frequency to the parturient tract and the urinary system as a region of infection after labor come the breasts. Infection of the nipples, and a consequent mammary inflammation or suppuration, is one of the most troublesome minor complications that the obstetrician is called upon to treat. By careful preparation of the nipple during the last month of pregnancy, and by extreme care to secure perfect cleanliness during the period of lactation, infection of the breasts can almost surely be avoided. If it occurs, the first effort should be to limit its extent and degree, and to prevent, if possible, suppuration. The best means to accomplish this end are derivation of the blood from the mammary glands by an active purge, compression of the gland-substance, and support of the breasts by a suitable mammary binder.

To these should be added, in the acute stage of inflammation, fomentations of very hot water, and later the application of cloths wrung out in lead-water and laudanum, renewed every three hours. Unless the infection has been of a virulent nature and the dose of infective material large, this plan of treatment will almost surely dissipate the inflammation and prevent suppuration.

The other infectious fevers of the puerperal state include the infectious diseases which can, under any circumstances, fasten themselves upon the adult female, and their treatment differs in no respect during the puerperium from that under ordinary circumstances, unless there should be developed some local complications.

Non-infectious Diseases of the Puerperium.

Anomalies of Involution.—Superinvolution, an exaggeration of that process by which the uterus is reduced to its normal size after labor, only manifests itself, as a rule, after the puerperal state is completed, and therefore its treatment need not be further considered.

Subinvolution, an arrested or retarded return of the uterus to its normal condition and dimensions after labor, is one of the commonest complications with which the obstetrician has to deal in the management of the puerperium. The cause of subinvolution is always a local one. General conditions, as acute fevers and so on, have no influence whatever upon the process of involution unless they are accompanied by some local complication.

There are two causes which prevent the involution of the uterus that must be borne in mind when one is called upon to treat subinvolution. The involution may be prevented, on the one hand, by anything which calls an excessive amount of blood to the uterine body, as, for instance, small fibroids within its wall or hypertrophied deciduous membrane remaining adherent to its inner surface. On the other hand, subinvolution may be the result of mechanical obstruction to the contraction of the uterine walls and the reduction of its cavity to the normal size. As an example of this we have a retained placenta or a submucous fibroid or adhesions dragging the uterus out of place and preventing its contraction, or, most commonly perhaps, an overdistended bladder and rectum.

In those conditions which result in a hyperæmia of the uterus the cause of an excessive blood-supply must be sought out and removed before one can remedy the subinvolution.

If small fibroids can be detected, the administration of quinine, ergot, and strychnine in pill form has been found most useful. If practicable, a faradic current may be employed in addition to medication. If there is an hypertrophied endometrium retained within the uterus, a curette will most quickly and effectually hasten involution. In cases of heart disease in which the blood-current is sluggish and dammed back into the large veins of the trunk digitalis will be the most effective remedy to overcome the subinvolution. There may be an active hyperæmia associated with inflammatory action, either in the uterine wall or upon its peritoneal covering, or in its adnexa; in this case the inflammation must be overcome by disinfection, the use of purgatives, counter-irritation and, possibly, the employment of hot-water douches, before involution can be secured. When there is mechanical obstruction to the return of the womb to its normal dimensions, the hindrance must of course be removed before one can expect a good result from treatment. In the case of retained

adherent placenta every effort must be made to remove the placental tissue. In the case of submucous fibroids their removal must be attempted if there is any hope of safely accomplishing it.

There is no case of labor which does not leave behind, in the parturient tract, some injury to the maternal structures. Usually, these injuries are slight in degree, manifesting no symptoms and healing spontaneously. Occasionally, the injury done results in fistulæ communicating with the bladder or rectum, in deep granulating wounds in the vagina, or in ulcerated sores.

In the case of fistula a cure can sometimes be effected without operative interference by touching the edges of the fistulous tract with nitric acid in order to excite an outpour of granulation tissue in the hope that it may plug up the opening. In deep tears which have not been primilarly united application of a solution of nitrate of silver will hasten the cure and prevent infection of the wounded surface. If ulceration occurs, the ulcerated spots are to be carefully watched and treated in the same manner.

Hæmorrhages from the birth-canal after labor depend upon a number of well-known causes, which must be sought out and corrected before the bleeding will cease. Most frequently the cause of a hæmorrhage will be found in retained fragments *in utero*, which must be removed. Not infrequently displacements of the uterus will be found as a cause, and correction of the displacement will stop the bleeding.

In interstitial bleeding after labor, resulting in hæmatoma, care must be taken to preserve the parts in as aseptic a condition as possible, while an attempt is made to limit the bleeding by the application of direct cold, preferably by means of a Barnes' bag dilated with ice-water, which must be removed from time to time in order to allow the lochia to escape. After rupture or incision of these blood-tumors the cavity left behind must be carefully disinfected with the bichloride-of-mercury solution or creolin, and, if necessary to control further bleeding, well packed with iodoform gauze.

Of all forms of bleeding, that which occurs directly after labor in consequence of inertia uteri, known as post-partum hæmorrhage, is the most frequent of occurrence and the most alarming and dangerous in its manifestations and consequences. No one should attend a case of obstetrics without having in mind a clearly-defined programme to be put in immediate execution when called upon to deal with this frequent and dangerous complication. There are two indications to be met: First, to control the hæmorrhage, and second, to treat the after-condition. The first indication is met by the following plan of treatment: The physician should give ergot in full dose by the mouth and, if need be, hypodermically. External stimulation of the uterus by knead-

ing and rubbing through the abdominal walls, as is practised in Credé's method of expressing the placenta should be first tried.

Next carry the other hand into the uterus and remove any blood-clots, pieces of placenta, or membrane that may be found there, while the internal surface of the uterine walls is irritated by the manipulations of the operator's fingers.

After this apply a small piece of ice upon the abdomen externally, and carry another piece the size of a hen's egg into the uterine cavity. The use of cold must not be persisted in for more than a minute at most, for its ultimate action is depressing and relaxing. Sprinkling ether upon the hypogastrium is an injurious method of applying cold externally.

Next soak a clean linen handkerchief in vinegar, carry it up to the fundus, and squeeze it out so that the vinegar shall run down over the uterine surface. Turpentine might be used instead of vinegar.

Next, hot water at a temperature of 116° or 120° F. should be injected into the uterine cavity.

Then if one happens to have the necessary appliances at hand (a small Gaiffe battery, which can be carried in an ordinary instrument-bag), a strong faradic current can be applied to the uterine muscle.

Finally, as a last resort, the uterine cavity may be packed with long strips of iodoform gauze in the manner suggested by Dührssen and carried out by a number of practitioners with gratifying success.

Drugs, as the styptic salts of iron, and especially Monsel's solution, have been recommended from time to time as intra-uterine applications in cases of post-partum hæmorrhage, but they are dangerous, for the coagulation produced by them may extend far into the uterine vessels, and the clots must be broken up by putrefaction, exposing the patient to the danger of septic poisoning.

This programme is to be carried out in the order given: if the milder measures suffice, of course the more radical plans of treatment will not be employed.

Excessive hæmorrhage (post-partum) from lacerations along the genital canal can be controlled by well-placed sutures.

Bearing in mind this plan of treatment, it is almost inconceivable that an intelligent and skilful practitioner should lose a case of post-partum hæmorrhage.

Treatment of the After-condition.—While the physician is busy controlling the hæmorrhage the nurse should administer a hypodermic injection of ether if symptoms of shock or collapse are manifested. After the bleeding has ceased it is well to administer an enema of a pint of hot water with a little salt in it (40 grains to the pint), which brings up the patient's temperature, relieves the shock, helps to fill the emptied blood-vessels and by its irritation promotes contraction of the

uterine muscle. This should be succeeded by small doses of hot, strong coffee, brandy-and-water, and a little warm milk if the stomach will retain it. As soon as reaction is well established half a pint of hot beef-tea should be administered, and $\frac{1}{8}$ grain of morphine may be given hypodermically in order to secure quiet and rest and to get the stimulant qualities which this drug undoubtedly possesses. Occasionally measures must be adopted to retain enough blood within the large vessels and in the heart to prevent excessive cerebral anæmia or cardiac failure. This is best done by auto-transfusion; that is, by bandaging the extremities toward the trunk in order to secure as large a quantity as possible of blood within the vessels of the trunk and brain. Actual transfusion of a $\frac{6}{10}$ of 1 per cent. solution of common salt into the blood-vessels is required when there are profound exhaustion and depression after hæmorrhage. It has been demonstrated that it is not necessary to throw this solution directly into the blood-vessels, as interstitial injections seem to answer the purpose equally well. A convenient place for the injection is the loose skin and connective tissue between the shoulder-blades.

THE MILK SECRETION during the puerperal state presents abnormalities which call for treatment. One may have to deal with anomalies of quantity or quality. The most frequent anomaly of quantity in milk secretion is unfortunately one of defect. Insufficient milk-supply depends on a number of causes. Perhaps the most frequent is a lack of development in the glandular tissue, and in this form of insufficient milk secretion no treatment can be of avail. Where the lack of milk is due to some intercurrent affection in the puerperal state the treatment must be directed toward this complication before the milk-supply can be re-established in normal quantity. It may be the consequence of hæmorrhage or of diarrhœa. It may be the result of an acute febrile attack during lactation or of inflammation within the gland itself. Serious organic disease may also be a cause, and insufficient nourishment must be held accountable in some cases. Profound emotions exert an extraordinary influence upon lactation in altering both the quantity and the quality of the milk. It has long been supposed that the return of menstruation has a disastrous influence upon milk secretion. This, however, has been definitely disproven by careful observations recently conducted in Austria. The simple return of menstruation without complications has no apparent influence, as a rule, upon the quantity or quality of the woman's milk. In all the temporary diseases interfering with milk secretion described above it should be borne in mind that on the disappearance of the abnormal general or local condition milk secretion can be successfully re-established, even though it be intermitted for days or weeks. Electricity has been much vaunted of late as a remedy for insufficient lactation. It may be appli-

cable in cases of torpidity of the mammary gland, or in those cases in which lactation has been suppressed on the birth of a first child, and the mammary gland, therefore, does not respond readily to the stimulus of subsequent births. This remedy will, however, often prove ineffective and disappointing. Quantitative anomalies in milk secretion by excess are not frequently met with. In the milder and simpler forms they can be managed by regulation of the diet and free purgation. Galactorrhœa, a constant flow of milk from the breasts, is one of the most stubborn forms of excessive milk secretion. Two measures can usually be relied on to give relief: firm compression of the mammary gland with the application of belladonna ointment, and the administration internally of iodide of potassium. In some cases of this sort milk secretion stops spontaneously with the return of menstruation, and in a certain proportion of cases a treatment to secure a discharge of blood from the uterus has been successful in stopping the flow of milk. Success has been obtained with Simpson's plan of introducing a piece of caustic within the uterus in order to bring back the menstrual flow. Warm douches have been used successfully for this purpose. Electricity has been recommended to secure the proper contraction of the sphincter muscles of the lactiferous ducts, but as this is usually a result and not a cause of the galactorrhœa, the use of electricity must prove in the vast majority of cases ineffective. The long-continued administration of ergot has been warmly recommended. The remedy should be tried, for its use seems rational. It has been demonstrated that all those drugs which bring about an increased arterial pressure in the parts promote milk secretion, while those which lower arterial pressure tend to diminish or even abolish the function. Chloral has been shown to be very effective in diminishing the quantity of milk. Therefore this drug is worthy of trial. It has recently been declared that antipyrine in $2\frac{1}{2}$-grain doses three times a day will diminish milk secretion. The drug, however, has not been often enough tested to demonstrate its power. Quantitative anomalies in the milk secretion most often depend upon an ill-regulated diet. A fatty diet will diminish the quantity of milk; a vegetable diet will diminish the casein, and fat will increase the sugar; a diet rich in meat, especially if reinforced with alcoholic stimulants, will increase the fat and casein, but will diminish the sugar. If the mother's milk is evidently disagreeing with the nursing infant, a chemical analysis of it should be made and on the result rules regulating the diet should be adopted. The most common mistake in practice is to over-feed a nursing woman, especially with a milk diet, with the idea which prevails extensively among the laity that the cow's milk poured into the stomach appears again in the mammary gland. It is usually sufficient for a nursing woman to observe the ordinary diet which agrees with her under all

circumstances, with the addition perhaps of a half-pint of milk midway between the morning and mid-day and mid-day and evening meals. Occasionally a wine-glassful of malt at the mid-day and evening meals is a useful addition to the diet, and in anæmic patients the addition to the malt of 5 grains of pyrophosphate of iron will be an advantage.

There is found in every pregnant woman some alteration in the constitution of the blood, which consists, roughly speaking, of a diminution of the red blood-corpuscles, the albumin, and the iron, with an increase in the white blood-corpuscles and the watery element. In some cases this change is much exaggerated, until an intense degree of anæmia appears in the puerperal state, which, in its severity, will stimulate pernicious anæmia or some fatal form of blood disease. The anæmia of puerperal women, however, even in exaggerated cases, usually yields to treatment in a most gratifying manner. After the prolonged use of Blaud's pills the writer has seen the blood-corpuscles rise from less than three to nearly four and a half millions, and the hæmoglobin increase from 40 to 75 per cent. in a few weeks. In some cases arsenic alone succeeds where iron fails completely.

Eclampsia.

To treat eclampsia intelligently and successfully it is necessary to understand its etiology as fully as modern knowledge permits. Although the subject needs more light from future investigation, enough is now known to justify the following statements:

1. The cell-activity of mother and fœtus produces excrementitious substances which will surely prove virulently poisonous to the whole organism unless they are voided or made harmless by the excretory organs.[1]

2. These organs in the childbearing woman are often inadequate to the disposal of effete material from the maternal and fœtal body.

3. Consequently, poisons of a nature not yet demonstrated are stored up in the maternal blood until, by cumulative action, their presence is manifested in the eclamptic seizure and other symptoms.

4. The convulsions are probably the result of an acute cerebral anæmia brought about by violent contraction of the arterioles, possibly the result of direct irritation of the brain-substance. In consequence of the intense muscular action the circulation is interfered with, and blood is determined to non-muscular regions, as the brain, lungs, kidneys, etc., to such a degree that the congestion of these parts becomes dangerous, leading to apoplexy in the brain, œdema in the lungs, and often a complete abrogation of renal function.

The indications for treatment in convulsive seizures of this nature

[1] Harold C. Ernst, *American System of Obstetrics*, vol. ii. p. 451.

are plain: First, to attack the *fons et origo mali*, to eliminate the poisons from the blood as quickly and in as large quantities as possible. Second, to diminish nervous sensibility and lessen muscular power, in order to reduce the convulsions in vehemence, duration, and frequency. Third, if convulsions occur during labor to save the infant without adding to the risk of the mother. Fourth, to guard the woman from injury during the attack.

The first indication is met by venesection, diaphoresis, and catharsis. By the first, one eliminates a certain quantity of poison along with the blood and relaxes the muscles. If there is sharp post-partum hæmorrhage, or if the patient is from any cause weak and anæmic, bloodletting is not called for. In the ordinary case, however, with full pulse, congested head, the veins standing out upon the neck and face, venesection is an undoubted advantage. It is not of itself enough. While the median basilic of one or both arms is being opened some croton oil should be obtained and 2 drops placed upon the tongue. Directions should at the same time be given to wring out three or, better, four old blankets in boiling water; these are to be wrapped around the legs, trunk, and arms and well covered over with one or more dry blankets. The sweating thus induced is profuse. An ice-bag must be put to the head to prevent over-congestion of the brain. In this way one eliminates the cause of eclamptic convulsions as quickly and thoroughly as possible directly from the blood, and indirectly through the skin and bowels. The latter may be acted upon by $\frac{1}{4}$ grain of elaterium rubbed up in butter, or by compound jalap powder and calomel instead of the croton oil. Pilocarpine seemed at one time an ideal remedy to secure diaphoresis in eclamptic cases, but it has lately fallen into well-deserved disrepute. It much increases the danger of pulmonary œdema and is too profound a depressant. It is no longer employed by experienced and educated obstetricians. The second indication is best met by an anæsthetic. Usually the convulsion first shows its approach in the eyes: these should be closely watched, so that on the first symptom of the oncoming attack chloroform may be at once administered and pushed as rapidly as possible. Ether is inadmissible in these cases, for it is slow of action, congests the brain, and irritates the kidneys. Just before the woman is wrapped in blankets 1 drachm of chloral in solution should be injected into the rectum. This may be repeated in an hour if necessary. Morphine, veratrum viride, and inhalations of nitrite of amyl have their enthusiastic advocates in this connection. They may be held in reserve in case the plan of treatment described needs reinforcement.

If convulsions come on during labor, the child should be rapidly extracted as soon as the os is well dilated.—not before, because efforts to dilate the os would be very apt to increase the convulsions, and

would attract the physician's attention from the woman's most threatening danger. Moreover, the os dilates naturally with unusual rapidity during eclampsia.

The only injury to be feared during eclamptic attacks is wounding of the tongue by the teeth. This can be prevented by inserting between the teeth a brush-handle wrapped in a handkerchief or by drawing a towel into the mouth like a bit. Well-meaning but ignorant bystanders will sometimes throw themselves upon an eclamptic patient to restrain her convulsions by force. This should be forbidden.

As there is considerable difference of opinion among physicians in regard to the best means of treating eclampsia, it would seem desirable, after presenting the foregoing sketch of the writer's plan, to give a detailed description of each of the different remedies advocated, with their comparative results:

Anæsthetization.—Chloroform will here be considered as the only anæsthetic to be employed. When this drug first came into general use it was regarded by many as a specific for eclampsia, and is so regarded by a few to-day. Hurd[1] writes that he heard Gilbert in 1868 advocate chloroform almost exclusively in eclampsia, and report 20 cases with no deaths. Hurd has had "upward" of 12 cases treated by this plan without a death, and he quotes 9 cases from another practitioner, all of which recovered. Charpentier reports 63 cases treated by chloroform alone, with 7 deaths, a mortality of 11 per cent.; but, on the other hand, the mortality from this treatment in the Maternité was 50 per cent. The place of chloroform in the treatment of eclampsia may be said now to be settled. No one, scarcely, would rely on it alone, but every one is willing to admit its value as an adjunct to other treatment.

Diaphoresis and Catharsis.—All are agreed that eclampsia is the result of some poisonous matter in the blood, and that this poison must be eliminated. The only emunctories available for quick and effectual action are those of the skin and bowels. No matter, therefore, what plan of medicinal treatment may be adopted, diaphoresis and catharsis must also be employed. Even Veit, the sturdiest advocate of a single-drug treatment for eclampsia, who used to tell his clinical audiences that they should never let their eclamptic patients die, after losing 2 out of 6 in a single year now admits that eliminative treatment must be employed in addition to his favorite remedy, morphine. My own practice is to employ a hot wet pack to excite sweating, and to use croton oil to move the bowels. For the latter purpose, however, compound jalap powder, calomel, concentrated Epsom salts solution, and elaterium are also good.

[1] "On the Treatment of Puerperal Convulsions," *Therapeutic Gazette*, 1889, p. 721.

Venesection.—Phlebotomy is at present in disfavor. The reaction against the indiscriminate use of the lancet has, however, gone too far. In Germany venesection for eclampsia has been discarded by many altogether, and in this country some who simply reflect European opinion without a very great personal experience unreservedly condemn it. While bleeding in every case of eclampsia will show bad results, there are many cases in which I am convinced it rescues the woman from an impending danger of pulmonary œdema and apoplexy. I understand that physicians in the country, who have to deal with strong, full-blooded people, are obliged in the treatment of pneumonia, as a routine practice, to use the lancet. In the same class of people bloodletting in eclampsia is equally necessary. For instance, in a recent report[1] of 15 cases, in which, from the text, bleeding seems to have been the only thing done, there was but 1 death. In appropriate cases the venesection should be done in time, and not, as in some German hospitals, only when symptoms of pulmonary œdema appear. The measure is preventive, not curative.

Morphine.—Older statistics of the morphine treatment for eclampsia show a death-rate of 57 per cent. (Winckel), but lately G. Veit[2] has published his plan of giving morphine in convulsions with results so striking as to arrest the attention of the medical world. In more than 60 cases there were but 2 deaths, a mortality of only 3.3 per cent.—the lowest death-rate yet attained by any plan of treatment. This result can only be obtained by giving very large doses of the drug. Veit has injected $\frac{1}{2}$ grain with each convulsive seizure, and has administered as much as 3 grains in four to seven hours and 4.5 grains in the twenty-four hours.

Chloral.—This drug has many advocates. Charpentier prefers it above all others, and presents statistics that justify the preference (114 cases, mortality 3.5 per cent.). Winckel recommends it most highly, and by its use has saved 85 out of 92 cases. This drug, too, must be given in large doses to be effective. From 30 to 60 grains should be administered by enema at a dose, and the physician need not hesitate to give as much as 3 drachms in the twenty-four hours, or even more.

Veratrum Viride.—The use of this drug is the American treatment of eclampsia. For the past twenty years it has been extensively employed in different parts of the country. But large as the number of cases must be in which veratrum viride has been given for eclampsia, we are not yet in a position to state positively its relative merits in comparison with chloral and morphine.

[1] Meachem, *Journ. American Med. Ass.*, 1889, p. 274.

[2] "Ueber die Behandlung der puerperalen Eclampsie," *Samml. klin. Vorträge*, 304.

Fearn[1] in 1871 reported 11 cases of his own, and 2 cases from the practice of professional friends, treated with very large doses of veratrum viride. None of the women died of the convulsions, but one succumbed later to puerperal sepsis. Rushmore[2] has recently collected 85 cases of eclampsia treated by veratrum viride, with 20 deaths, a mortality of 23.5 per cent. Jewett reported to the American Gynæcological Society in 1887, 22 cases of eclampsia treated by veratrum viride. Four of the women died of the convulsions, a mortality of 18 per cent. Dr. Newton[3] writes that "Dr. Cutler twenty-eight years ago stated in the New Jersey Academy of Medicine that he had been in practice twenty-five years, and that during that time he had seen on an average 8 cases of puerperal convulsions a year (?), that he had never lost a case, and that he relied upon veratrum viride in the treatment." Further, that "Dr. Love used a combination of veratrum viride and benzoic acid, and in 23 cases of eclampsia he has not lost a case." In 50 cases of eclampsia collected by Trimble[4] veratrum gave much the best results. In 26 cases treated by this drug there were 3 deaths, while in the remaining 24 cases there were 6 deaths a mortality respectively of 11.5 per cent. and 25 per cent.

The remedial measures just alluded to comprise all, in my judgment, that are in the field of practical medicine. The treatment by *ante-mortem* Cæsarean section, proposed by Halbertsma, I regard as not yet established among the justifiable procedures in this disease. Caffeine, oxygen,[5] and nitrite of amyl have not been used often enough to justify an opinion of their worth; and this judgment must be passed on a number of other drugs recommended from time to time. Pilocarpine is simply mentioned to be condemned.

I think that a careful analysis of the different plans of treatment will award the palm to chloral, with diaphoresis and catharsis, anæsthetization, and occasionally venesection. Morphine, it is true, gives the best record—3.3 per cent.—but this was in the hands of a single individual, and his report would be more impressive were it more exact. Thus, he says that in "more than thirty years" he has had "more than 60 cases of eclampsia." In that period one's memory could easily play him false, both as to the number of cases and the results. Chloral, on the other hand, has achieved brilliant results in different hands and places. I should like to see veratrum viride more extensively tried, and I would be glad to unite with others holding hospital positions to give it a thorough test under favorable conditions. I believe the results would be excellent—would, perhaps, challenge

[1] *Amer. Journ. of Obstet.*, 1871, p. 28. [2] *Gaillard's Med. Journ.*, Nov., 1887.
[3] *Medical Record*, 1889, p. 257.
[4] "Puerperal Eclampsia," *Am. Journ. of Obstet.*, 1890, p. 833.
[5] Employed in 9 cases with 6 recoveries (Auvard).

those of chloral. But as the case stands at present it seems to me that the conscientious physician must depend upon chloral, at least in private practice, until the equality or superiority of some other plan of treatment is proved. Perhaps a combination of chloral and veratrum —one by the bowel, the other hypodermically—will give better results than either remedy alone. This I intend to test at the first opportunity.

GENERAL CONSIDERATIONS OF THE TREATMENT OF THE EYE AND ITS DISORDERS.

By W. F. MITTENDORF, M. D.

Preliminary Remarks.

The examination of a diseased eye in order to make a diagnosis and to determine the proper remedies to be used is at times a very difficult matter, especially if there is much dread of light, *photophobia*, accompanying the disease, or if the inflammation affects the different parts of the eyeball itself and makes this extremely sensitive to the touch, or if there is so much swelling of the lids that the eyeball can be exposed only after great efforts. Such patients are apt to close their lids tightly, and especially in young children no amount of coaxing will induce them to open the eyes of their own accord.

Nearly 75 per cent. of all diseases of the eyes can be diagnosed by a careful and systematic examination of the exterior of the eyelids and eyeball. It is therefore important to know how such an examination should be made.

The three principal symptoms which eye-patients will complain of are either impaired vision, pain, or discharges from the eye. The first symptom, *impairment of vision*, is seldom found as a sign of disease of the eyelids or of the appendages of the eye. It points, as a rule, to a cloudy cornea, an opaque lens, a hazy vitreous, or disease of the iris, the retina, the optic nerve, or the choroid. It may, however, be the result of an error of refraction, and as such it has, as a rule, existed for a long period, and is not accompanied by any signs of disease. An ophthalmoscopic examination is therefore necessary for the making of a correct diagnosis in these cases.

Pain accompanies most of the inflammatory processes of the eye: it is less marked in conjunctival diseases, unless the cornea or iris becomes involved, and is rarely found in affections of the eyelids, perhaps with the exception of the formation of an abscess or a stye. Pain is, however, a very prominent symptom in affections of the cornea, the iris, and the ciliary body. The pain is not confined to the eyeball, which, as a rule, is likewise very sensitive to the touch, but it is apt

to extend along the branches of the infraorbital nerve, and especially along those of the supraorbital nerve, assuming here a hemicranial character, and may extend to the back of the head. Pain also accompanies the great majority of glaucomatous attacks, and is then of so severe a character that it may lead to nausea and vomiting in the acute forms of the disease. Pain is at times a very important symptom of those reflex neuroses known under the name of asthenopia. It is then spoken of as an ocular headache. Eyes affected in this manner are usually perfectly free from any signs of inflammation, and the pain is often promptly relieved by the use of proper glasses, without any medication.

Discharges from the eye are either watery, mucoid, or purulent. A watery condition of the eye does not always indicate the existence of inflammation. It may be due to an increased secretion of tears or to an obstruction of the lachrymal passages. A hypersecretion of tear-fluid may accompany the initial stage of an inflammation of the conjunctiva, but frequently it is the result of some irritation which may be caused by the presence of a foreign body in the conjunctival sac or on the cornea, or it may be due to the contact of irritating chemicals, such as, for instance, the vapors of ammonia and the presence of small quantities of acids or caustics in the eye. It follows likewise the application of medicines to the conjunctiva, and is very frequently found as a prominent symptom of diseases of the cornea, the iris, and the ciliary body. Lachrymation is likewise a very prominent symptom in phlyctenular conjunctivitis and keratitis, frequently spoken of as scrofulous ophthalmia.

A mucoid discharge is met with in diseases of the conjunctiva, especially those of a catarrhal nature. It may vary greatly in quantity, showing itself in the corners of the eye after sleeping as a small crust, or in the severer cases it may be constantly flowing over the cheek. It is principally composed of flakes of epithelial cells and a muco-albuminoid secretion mixed with tear-fluid. Although the carrier of the bacillus of conjunctivitis, it is not quite so dangerous in regard to contagion as a purulent discharge. A mucoid secretion evaporates easily on the hot and inflamed lids, and is the principal cause of the gluing together of the lids during sleep in cases of conjunctivitis.

A purulent discharge is the indication of a severer form of inflammation of the eye, and especially of the conjunctiva. It is not infrequently loaded with the gonococcus of Neisser, and is then always very contagious: a rare exception to this is purulent discharge following the breaking of an abscess into the conjunctival sac. The presence of a purulent discharge calls at once for the use of a disinfectant, both for the eye of the patient and the hands of the

examiner. The greatest care is necessary in this respect, as the physician may poison his own eye, and may possibly lose it in consequence. It calls likewise for the immediate protection of the good eye of the patient, as this becomes frequently infected by the direct flow of the discharge over the bridge of the nose during sleep or is carried there by the hands of the patient or by means of towels and handkerchiefs used by the patient for cleansing his eyes.

The severer forms of conjunctivitis are usually accompanied by intense swelling of the eyelids and also of the conjunctiva of the eyeball (*chemosis*), and an examination of the entire conjunctival sac of such eyes is very difficult, and very painful even if done by the most skilful and delicate hands of an expert.

By directing the patient to look upward, and then drawing down the lower lid by traction on its integument, the lower half of the conjunctival sac will be exposed to view. The examination of the upper half is, however, more difficult. It is best accomplished by following these directions: The thumb of the left hand of the examiner should be pressed firmly against the brow in order to prevent the occipito-frontalis muscles from drawing the lid upward. The patient must be directed to look in a downward direction, with both eyes if possible. The ciliæ of the upper lid are then seized with the fingers of the right hand and drawn gently downward and forward, thus lifting the lid a little from the eyeball. The left thumb, holding the eyebrow, must now be moved downward, pushing the skin of the brow and upper lid into the depression caused by the downward look of the patient. If the eyelashes are then drawn upward, a little additional pressure of the thumb of the left hand will make the entire upper fold of transudation bulge forward, exposing at the same time the upper half of the eyeball, especially if the patient is urged to persist in looking downward. Any foreign body which might have been hidden under the upper lid can be readily seen, or the diseased conjunctiva can be examined and thoroughly and effectually treated.

For the eversion of the upper lid the use of a pencil or match is sometimes of great help if the examiner has not much experience in this line. In this case direct the patient to look downward, seize the upper ciliæ with the left hand, and exert gentle pressure on the upper lid by means of the probe or pencil, and roll the lid out over it. It is, however, better if the lids can be everted with the hands only, as the patients, especially if they are children, dread to have any instrument brought near their eyes. If there is much pain or great irritation or much photophobia, it is sometimes very difficult to resist the action of the sphincter of the orbicularis, and the use of an anæsthetic has to be resorted to in very obstinate cases. The rule should always be never to treat an inflamed eye without examining the entire

surface of the conjunctiva and cornea, as the treatment will have to be entirely different if the latter organ is also affected.

In severe cases of blepharospasm the use of a lid-retractor will prove of great benefit for the examination of the cornea, but it is of no value in the examination of the conjunctiva. If the patient is a small child, it is best to hold the head between your knees, push down the eyebrows with the left hand, and evert the lid by traction of the eyelashes with the other hand. If it becomes necessary to use an anæsthetic in order to open the eye, it is best to pour a few drops of Squibb's chloroform on a towel and make the child inhale the vapors for a few seconds, when the lids can be everted and the eyeball inspected with perfect ease. The discovery of a foreign body in the eye may only be possible in this manner, as the pain and irritation produced by it are very severe. The use of cocaine has done away with the general anæsthetics even in these cases; yet the use of a little chloroform may be necessary in small children, especially if the foreign body is located on the cornea. If the foreign body is black, as it is most apt to be, its presence on the cornea of persons with a dark iris is not easily detected. The use of a strong magnifying lens or the method of oblique illumination will be of great help in these cases. The ordinary bright daylight or the light of the flame of a candle is concentrated and thrown obliquely on the cornea by means of a strong convex lens. The point of light being now gradually moved over the entire cornea, the least change in the transparency of this organ, the slightest scratch, or the smallest foreign body on its surface can be easily discovered. This method is likewise of help for the examination of the contents of the anterior chamber, for irregularities of the iris, and for the discovery of cataract. For the last-named affection, however, the use of the ophthalmoscope is of greater importance. The discovery of a foreign body on the cornea of a blue eye is much easier, and is often accomplished without the use of a magnifying lens. If the foreign body is very small and if located in front of the pupillary space, its presence may be readily discovered by means of the ophthalmoscope.

The appearance of *the pupils* is a matter of great importance: their size and the equality of the pupils of both eyes should be noted. Immobility, a contracted state and irregularity of the pupil, indicates, if associated with inflammatory symptoms, an iritis. Irregularity of the pupil alone, without signs of an inflammation, is usually due to posterior synechiæ, the remains of a previous iritis; and an adhesion of the pupillary border of the iris to the cornea, known as an *anterior* synechia, is an indication of a perforation of the cornea. If the cornea remains perfectly clear, the adhesion is probably the result of a penetrating wound of this organ; if associated with an

opaque condition, it is probably due to an old ulcer; the opacity varies of course with the size of the previously existing ulcer. This condition is likewise known as a prolapse of the iris. In many instances its occurrence can be avoided or relieved by proper attention.

At times the pupillary space may be filled by a mass of exudation, the result of a neglected iritis. This condition may be easily mistaken for cataract. However, as we have a perfect freedom of the pupil to dilate or contract in cataract, and as the pupil is firmly bound down in the other condition, making any motion of it impossible, the diagnosis is not difficult to make. Oblique illumination, as spoken of before, will be of great help in arriving at a diagnosis. The well-known behavior of the pupil, not to contract on exposure to light, but readily when looking at a near object (the Argyll-Robertson pupil), is one of the early symptoms of locomotor ataxia.

A change of the *transparency of the cornea* is a sign of infiltration of this organ, and indicates the existence of an inflammation of the cornea—keratitis. It is usually accompanied by a zone of bluish-red, radiating blood-vessels, with dread of light, lachrymation, and more or less pain in the eye or along the supra- and infraorbital nerve, and tenderness of the eyeball to the slightest touch. If not accompanied by inflammatory symptoms, opacities of the cornea are usually the sequelæ of a previous injury or disease of this organ. These opacities may resemble a faint haze, nebula, or form a defined spot, macula, or may be dense and white, leucoma.

An *œdematous condition* of the eyelids may be entirely local, or it may be a sign of constitutional disease; as, for instance, the œdema of the lower lids which is sometimes one of the earliest symptoms of renal disease, and which may also be due to a faulty circulation or may be associated with diseases of the eye. Entirely local, it may be due to an erythematous condition of the lid; it may be of slight eczematous nature, or it may be simply due to the bite of an insect. In all these cases there is more or less redness, and at times roughness of the skin, associated with it. In persons with a lowered condition of health, especially in strumous individuals, it sometimes accompanies very slight attacks of conjunctivitis, and presents an alarming appearance, though the conjunctival trouble may be slight and insignificant.

Increased vascularity of the eyeball or of the conjunctiva is of great value in regard to diagnosis and treatment. If the congestion is confined to the more peripheral parts of the eyeball and to the cul-de-sacs, and if it affects principally the larger superficial vessels, and especially if the palpebral conjunctiva is of a deep-red, almost velvety, appearance, the disease is in all probability a conjunctival one, requiring for its cure cold applications and astringents. If the

injection is, however, more marked near the sclero-corneal border, and is in the shape of fine deep-seated vessels of a rosy or bluish-red appearance, principally radiating from the cornea toward the more peripheral parts of the eyeball, the disease has its seat probably in the cornea or in the iris or in the ciliary body; especially if the injection is more or less in spots, intensely red, and very painful to the touch, it is probably in the latter. In all these affections hot applications and the use of mydriatics, and sometimes of myotics, is indicated, whereas all harsh or astringent remedies should, as a rule, be avoided. Even the irritating effect of bright lights should be guarded against by the use of tinted, especially smoke-colored, glasses or by keeping the patient in a dark room.

The *tension* of the eyeball is usually tested by exerting alternating pressure of two fingers placed on the upper lid, the patient looking in a downward direction. It can be done by using the two index fingers upon one eye at a time, or testing the two eyes at once by placing the index and middle fingers of each hand on the eyes. A slight variation of the tension of the two eyes can be easily discovered, and indicates, if the eye feels harder than the normal, that the tension of the interior of this eye is increased, and that it is probably glaucomatous. A softening of the eye, if slight, may not be of importance, but if marked it is usually the sign of a very serious trouble, and may mean approaching and often incurable blindness. If an eyeball is very hard, or, in other words, shows a marked increase of tension, indicating the presence of glaucoma, an operation—paracentesis of the cornea, an iridectomy, or a sclerotomy—may preserve the amount of vision which the eye has at the time of the operation, and may even improve it; but if the tension of the eye is greatly diminished, and the sight at the same time poor, nothing can be done to save the eye; and if such an eye is quite sensitive to the touch of the finger, and especially if an injury has been met with previously, operative or otherwise, the removal of the entire eyeball from the orbit may become necessary.

The *direction of the eyeballs* is next to be considered. If one of them is rotated inward, upward, downward, or outward, it gives us respectively the different varieties of squint. These conditions may be due to or may accompany errors of refraction, and are then spoken of as concomitant squint. At times they are due to paralysis of the different external muscles of the eye, and are then known as paralytic squint. In the latter variety, which usually develops in adult life, the mobility of one eye is always interfered with, and it will, as a rule, develop in adult life; whereas the other forms of squint do not interfere with the mobility of the affected eye, and the condition had its beginning, in nearly all cases, during early infancy. Perhaps, principally on this

account, these patients are not troubled with diplopia, which they learned early to suppress; whereas seeing double is the most annoying symptom in cases of paralytic squint. Double sight may likewise be an early symptom of orbital disease, and the true cause of it may be hard to discover in such cases; but as the displacement of the eyeball becomes more marked and produces exophthalmus, the diagnosis becomes easy.

Eruptions of the face and lids may be of great service in diagnosing diseases of the eye, and guide us in the selection of our remedies. Specific eruptions of the face and forehead, spoken of as a corona veneris, associated with an inflammation of the iris, will make us think at once of a specific iritis. An ulcer of the cornea or a localized conjunctivitis in conjunction with an eruption in the course of the supraorbital nerve indicates herpes zoster. Eczematous patches of the lids or the ears or excoriations of the nose of a child sick with sore eyes should make us look for phlyctenular disease of the cornea or conjunctiva. Ulcerations and excoriations of the nose and fissures of the lips, peculiar formation of the bones of the forehead and palate, and the notched teeth of Hutchinson in a young patient with disease of the cornea, point to inherited syphilis. Other eruptions of the lids are easily recognized, and do not, as a rule, differ from eruptions of other parts of the body.

Disturbances of the mobility of the lids may indicate a paralysis of the facial nerve if the patient cannot close his eyes on account of paralysis of the orbicularis muscles. If the eye cannot be opened on account of paralysis of the levator of the upper lid, the third or motor oculi nerve must be involved. If the upper eyelid, however, is thick and cannot be opened readily because it is too heavy, it indicates that conjunctival affections, and among them principally granular lids, are or have been the cause of the trouble, as it may exist even for some time after the granular lids have been cured. A thickening of the free edge of the lids is sometimes seen in scrofulous children as the result of the existence of phlyctenular disease of the eye.

A turning in or out of the free edge of the lid is a deformity which can be easily diagnosed. The former, as well as turning in of the lashes (trichiasis), is usually the result of granular lids, which cause contraction and shrinking of the conjunctiva and changes of the curvature of the so-called cartilages of the lids.

The turning out of the conjunctival surface of the lids is called ectropion: it is usually the result of a contracting scar of the integument of the lids, and if affecting the lower lid it may be due to relaxation of the muscle after severe inflammations of the conjunctiva.

Diseases of the free edge of the lid are indicated by the formation of scales, crusts, or ulcers, and are accompanied by partial or total loss of

eyelashes, as well as by thickening of the margin, and in severe cases by destruction of the free edge, of the lid (lippitudo).

Tumor of the lids is readily seen, and may disfigure the patient considerably. If at or near the free edge of the lid, accompanied by more or less inflammatory signs, it is usually a hordeolum; if slow in progress, free from inflammation, and not involving the edge of the lid, the tumor is apt to involve one or more of the Meibomian glands, and is known as a chalazion. Ulcerations and cancerous affections can be easily diagnosed, likewise the smaller cysts and growths found here, such as warts. Even pediculi may be the source of eye troubles, at least of the eyelids. By means of a magnifying lens their presence is easily discovered and on the eyelashes their eggs are found.

Deep-seated diseases of the eye, such as affect the interior of the eyeball, require the aid of the ophthalmoscope for diagnosis.

Treatment.

In the treatment of a diseased eye the following points are of great importance: The first is to procure absolute rest; the second is protection from light; the third includes local applications; and the fourth, general remedies.

Absolute rest is obtained by cessation of all near work. Accommodative efforts, such as for reading, writing, or careful examination of near objects, are intimately associated with convergence, and both of these acts require muscular strain both of the external and the internal muscles of the eye, and are not only painful and fatiguing whenever the muscular apparatus of the eye is the seat of disease, but lead to compression and friction of the external parts of the eye, so as to irritate these: they interfere, likewise, with the circulation of the eye sufficiently, by compression of the vorticose veins, to lead to congestion of the inner, and especially of the vascular, tunics of the eye. By compression of the angular veins such work will, as a matter of of course, increase any existing hyperæmia of the conjunctival vessels, and thus create, even in slight cases of catarrhal inflammations of the conjunctiva, the annoying symptoms which the distended veins produce by their friction against the eyeball, and which the patient complains of as a sensation of sand in the eye. These distended vessels act like a foreign body, and set up lachrymation and the sensation of itching or cause a dry, gritty feeling of the eye, and naturally aggravate the existing hyperæmia of the tissues to such an extent that many relapses of eye diseases are entirely due to this cause.

Absolute rest is, however, of the greatest importance in those affections of the eye which involve the muscular apparatus itself. The internal muscles, those of the iris, and especially the all-important

ciliary muscle, must be kept quiet when in a state of disease or irritation. The best way to accomplish this is to use a powerful mydriatic, such as atropine or duboisine, which produces paralysis of accommodation, and, as a matter of course, perfect rest of the parts, near work being quite impossible after its use.

In injuries of the cornea or the sclera, and even in traumatic iritis, the question of complete rest of the eye can be solved in two ways: If there is any fear of inflammation following the injury, iced cloths may be applied to the eye continuously or the eye may have to be bandaged. The first method is known as applying iced compresses to the eye; the other is called a compress bandage.

Compresses are applied either cold or hot. The first may be made by using pledgets of absorbent cotton or pieces of old linen cut in squares and folded to two or three thicknesses as the case may call for, and immersing these cloths or pledgets of absorbent cotton in cold water where no ice is to be had, or by cooling them in the following manner: A large piece of ice is placed near the bed on which the patient rests, and a number of pieces of cloth are placed upon it, and from there removed to the closed eyelids. A sufficient number of cloths should be kept on the ice, so that they are constantly and uniformly cold, no matter how often they are used or renewed. These pieces of cloth or cotton should be of sufficient thickness to retain the cold for a little while, and yet not so thick that they will cause discomfort to the patient on account of their weight; nor should they be so wet as to cause the water to flow down on the side of the face, and perhaps even into the ears, of the patient. In very young children or delicate patients the cold, if too intense, may lead to necrosis of the cornea.

If these applications are made to eyes suffering from injury, the pledgets of cloth may be used over again; but in all cases where there is any discharge of a contagious nature each pledget should be destroyed after it has been on the eye.

In those cases where the disease is well established in one eye, and only threatening or just beginning in the other, two different sets of compresses should be kept in use; and in these cases it is better to use small pieces of old linen to the slightly affected, and pledgets of cotton to the more inflamed, eye. Although there is little danger of contagion on account of the low temperature at which these compresses are kept, yet the water running down from them may become a source of danger to the sound eye, and in all serious, or better in all contagious, cases of conjunctivitis the sound eye should be protected by means of a Buller eye-shield, which consists of a watch-glass placed over the eye and retained there by means of strips of adhesive plaster or by gluing it to the face of the patient by means of collodion. It is well, how-

ever, to leave the outer corner free, as there is less danger of contagion at this place, and as this precaution prevents the accumulation of moisture on the inner side of the watch-glass, which would interfere with the examination of the eye and prevent the patient from seeing through it. A piece of ordinary cotton may be twisted into a long band, and placed between the edge of the watch-glass and the skin of the patient; another roll is placed now over and outside of the edge of the glass, and the whole margin painted with flexible collodion until it is firmly adherent to the face and perfectly watertight at the same time. The neglect to protect the sound eye in this manner in all cases of severe contagious inflammations of the eye constitutes a great carelessness on the part of the attending surgeon, as it may lead to total blindness of the patient.

The frequency with which these applications should be renewed depends upon the severity of the case. In injuries it will be sufficient to renew the pledgets perhaps every two or three minutes or as soon as they become warm. In cases of severe inflammation, however, the constant renewal of the compresses should be kept up night and day. In cases of this kind it is hardly possible for one nurse to continue in uninterrupted attendance upon the patient, and it will become necessary to have at least two faithful nurses. The greatest danger in making these applications is that they may be left too long on the eye, become warm, and act like poultices, when they may do actually more harm than good.

Hot compresses are usually called for in all cases of cyclitis, iritis, and keratitis. In some instances they may be required even after injuries, but then only after an inflammation has established itself. They are, however, of the greatest importance in all cases of idiopathic keratitis or iritis. In order to retain their heat as long as possible, these pledgets should be thicker than those used for cold compresses, and they should, as a rule, not be applied as continuously: a period of from ten to thirty minutes is in most cases sufficiently long. Such applications should be made several times a day, according to the severity of the case. In all cases of cyclitis, especially in those following cataract operations, they should be of a temperature as hot as the patient can bear them; they may have to be used continuously for some time, until the desired relief has been obtained. It is surprising how hot these compresses may be used; they may be hot enough to scald our fingers, and yet they feel only grateful to the eye of the patient.

Another way of obtaining complete rest of the eye is to bandage it. The *compress bandage* usually employed consists of a strip of soft flannel about one inch wide and four yards long: white flannel is to be preferred in all cases, because it will not discolor the face if it

should get wet from water or perspiration. Flannel is far superior to linen or any other material for this purpose, because it is somewhat elastic, and the pressure which it exerts upon the eye is therefore more agreeable to the patient; it absorbs moisture and perspiration rapidly, and never feels chilly, and it will adapt itself to the shape of the head very readily. Before the bandage is applied the eye should be thoroughly cleansed and all traces of mucus or crusts on the edges of the lids should be carefully removed.

Medicines to be applied should now be instilled into the conjunctival sac, and after removing the surplus the patient is directed to close the eye gently, as if he intended to sleep. Forcible closure of the lids is to be avoided, as the eye would soon begin to feel uncomfortable, nor should the patient attempt to open the eye at the time the bandage is applied, as the eyelashes would probably be pressed against the eyeball. A round piece of fine linen cloth of the size of a silver dollar is placed over the closed lids; the side which touches the lids should previously be smeared with vaseline or boric-acid ointment (1 drachm to 1 ounce of vaseline); over this is placed a thick layer of absorbent or borated cotton; and now the bandage is to be applied by beginning under the ear of the side of the eye to be bandaged, and is held here by the finger of an assistant or by the patient himself. The operator, standing in front of the patient, carries the bandage now across the eye and once around the head. Reaching on the next turn the back of the head, the bandage is passed below the ear to the point of beginning; from here it should be carried across the eye and around the head once more, and fastened by means of pins. It is during the second turn, just on passing over the eye, that traction has to be applied in order to exert more or less pressure upon this organ. In very unruly patients or where a great deal of pressure is desired—for instance, after the removal of the eyeball—the bandage may be carried three, or even five, times across the eye and around the head. If the bandage is too tight, it may constrict the circulation of the head and cause intense headache, or the pressure may be felt so keenly in the eye that the patient will plead for its removal. In ordinary cases this may be done readily, but if it is desirable not to disturb the eye at all, the bandage may be partly divided by means of scissors or a knife. The discomfort is apt to be felt especially under the ear, and in this case a small incision of the bandage at this point may become necessary. The bandage may, if preferred, be passed around the head first and then over the eye.

Another form of bandage consists of an oblong piece of flannel, to cover both eyes, with a notch for the nose, and four ribbons at the corners, which are to be tied at the back of the head. This bandage is especially useful where both eyes are to be bandaged or where

drugs have to be frequently applied to the eyes; for instance, after burns or other injuries. However, the ordinary roller bandage may be applied to both eyes by passing it first over one eye, then around the head, and over the other eye to the head again, and so on.

In warm weather a gauze bandage, or, better, a strip of antiseptic gauze, may be used in place of the flannel, as it is much cooler and possesses enough elasticity to be comfortable. Roller bandages of muslin or linen should be used only exceptionally and with great care: they are either liable to feel too tight and cause pain, or they become loose and alarm the patient on this account, especially if this should happen during the night, when it cannot always conveniently be reapplied.

The indications for the use of a bandage are when the motion of the lids over the eyeball will keep up constant irritation, and when, after an operation, it is desired to keep the part very quiet and prevent extravasations at the same time. Its use is especially to be recommended in all rough and irregular wounds of the cornea, such as scratches by means of blunt objects; for instance, the finger-nail, the branch of a tree, the edge of a piece of paper, a blade of grass, or the husk of grain—in fact, those objects which make an irregular wound with more or less loss of epithelial cells.

In nearly all cases of ulcerations of the cornea, provided they are not complicated by copious discharges from the conjunctiva or by secretions of an inflamed tear-sac, a bandage will be of the greatest service. In such instances the bandage must be applied firmly enough to prevent the motion of the lid, and yet it must not exert too much pressure on the eyeball, which is apt to be quite sore to the touch. The same rule applies to bandages which may be used in cases of iritis, but if ulceration of the cornea or iritis is complicated by the accumulation of pus in the anterior chamber (hypopyon), a firmly-applied bandage may be of great service, and large quantities of pus which previously remained obstinately in the eye may disappear in less than twenty-four hours.

The greatest care should be exercised in the application of a bandage after cataract extractions, as an uneven distribution of the cotton under the bandage may exert unequal pressure upon the eye and prevent an even and prompt healing of the wound. For this reason it has been proposed to cover the lids with soft isinglass plaster, which would make a perfect mould for the eyeball by simply closing the eyelids and preventing their motion. However, a carefully applied bandage affords more protection against injuries and prevents interference on the part of the patient; and if both eyes are bandaged the patient has not only to keep quiet, but no motions of the eyeballs are called for, and the rest is as complete as it can be made.

Bandaging of both eyes is only necessary after more serious opera-

tions upon the eyeball, especially when the wound opens into the interior of the eyeball: it is therefore of importance after iridectomies, especially the more extensive ones, as for glaucoma; after the removal of foreign bodies from the interior of the eye, especially if the magnet was used for this purpose; after operations upon the retina, for detachment of cysticercus, for instance; after sclerotomies; and after cataract extractions. The bandage should be worn for several days, until the wound is closed. In slighter operations the bandage should be worn for one or two days only.

Great pressure, such as elastic sponge pressure, has to be used after operations which are liable to be followed by œdematous infiltration of the parts near the wound. It is of great help in all operations upon the lids, and it should be resorted to especially after enucleations. After operations, such as for entropion or distichiasis, a sponge pressure bandage assures the most perfect coaptation of the margins of the wound, and as it prevents swelling a more perfect and rapid healing of the parts is obtained. It is, however, after enucleations that sponge pressure is of the greatest value. All œdematous infiltration of the orbit and the lids is avoided, and healing is in most cases so rapid that an artificial eye may be inserted within eight or ten days after the operation. The bandage should be applied in the following way: A large piece of soft linen, to which boric-acid ointment has been freely applied, is placed over the closed lids immediately after the hæmorrhage following the operation has ceased, and the wound thoroughly cleansed by means of a solution of boric acid; a soft, well-cleansed surgeon's sponge is now pressed against the linen; over this a liberal quantity of absorbent cotton is placed, and over this the flannel bandage is applied as firmly as the patient can bear it. This bandage is to be changed every twenty-four hours for two, three, or four days; in fact, as long as any trace of œdematous conditions of the lids or the conjunctiva can be observed. After the removal of the bandage the wound and the conjunctiva are to be treated in the usual way. Washing the parts with a concentrated solution of boric acid every two or three hours is usually sufficient, and the artificial eye may be inserted in a few days. Suture of the conjunctiva after the removal of the eyeball is rarely needed if the stump is treated in this manner.

Shades are made to cover either one or both eyes. Their use is popular, but in the great majority of cases smoked glasses are preferable, especially in cases of inflammation. After an injury, to hide the appearance of a "black eye," shades are very serviceable; likewise in those cases where the inflammation or injury of one eye is not severe enough to keep the patient from using the other eye. Large shades to protect both eyes are of great assistance to people who have to work

near bright artificial lights; they are also used by patients when both eyes are inflamed, especially when they can remain in-doors; they are likewise very pleasant in the first days after the removal of the bandage in severe operations, such as cataract extractions or iridectomies.

Shades of this kind are usually made of stiff pasteboard: they should be covered with a dark material; black or green silk is usually employed for this purpose. One great objection to the use of shades, especially the single one, is that they are liable to come in contact with the secretions of the eye, and that they come too close to the eye, causing friction and subsequent irritation of the lids. Not unfrequently they are so close to the eye as to act like poultices. The color of the silk used to cover the shade is liable in such cases to become another source of irritation. The shades are usually fastened to the head by means of an elastic band, which if it is too tight may cause headache, and may even interfere with the circulation. Very small double shades may be fastened to a nose-glass frame, and are worn with great comfort by bookkeepers and jewellers. The larger shades, which are used to protect both eyes, are usually kept in place by means of wires or springs. These shades are generally made entirely of paper, the outer side having a black, the inner side a dark-green, color.

Shades should never be used for small children, who are apt to rub them against the eye, soil the lower side of the shade with the secretion of the eye, and, after it has become wet, poison their eyes with the dye. In such cases shades may do much more harm than good.

Colored Glasses.—For the protection of the eye it sometimes becomes necessary to exclude the light or to change its composition. The first is done by dark or stenopæic glasses, the latter by colored ones. In the first case we regulate the quantity of light that reaches the eye; in the second, we change its quality.

In very bright light the quantity of it that reaches the retina, even through the smallest pupil, may be so great as to interfere with good vision, as it may not be possible for the pigment of the background or the interior of the eye to absorb the superabundant light, which now interferes with the incoming rays and causes circles of diffusion. This is usually the case with albinos. The effect of this is not only difficulty of vision, which is spoken of as dazzling, but the irritation of the light may lead to serious disturbances of the retina and to intense pain in and around the eye. The conjunctiva of the eyelids and eyeballs may become greatly irritated and inflamed. It may even cause a sunburnt condition of the conjunctiva of the eyeball, as occurs in the skin of the exposed face. Annoying as this condition may be in the bright sunlight, especially on the water or on the sands of the seashore, it will become a much more serious condition on extensive

snowfields, where we may have the drifting of fine, sharp snow-crystals accompanying and increasing the difficulty; this has at times not only led to loss of vision, but also to loss of life. This disease is spoken of as snow-blindness, and is the great dread of travellers in the Arctic regions or high altitudes. But even in the temperate zone it may become a great source of danger to the traveller crossing extensive plains covered with snow, especially in bright windy weather.

The most primitive protections for the eyes in such conditions are the wooden spectacles of the Esquimaux. They consist of small pieces of wood with a small central hole or oblong opening in them, and are fastened over the eyes by means of cords or narrow ribbons.

The modern protections of this kind consist of dark glass: they are made flat and the usual shape of eye-glasses, or they are curved like shells and called coquilles. According to the requirements we have either a very faint tint of smoke—as, for instance, in ordinary driving-glasses—or we have them dark for patients with very sensitive eyes. Between these are numerous shades. As a rule, we designate the lightest shade by Smoke 1, the darkest as Smoke 6. The intervening shades are employed as the needs of the patient may require them.

Flat glasses are better for the eye, but they do not afford much protection, the light reaching the eye around the glass. In order to avoid this, side-pieces are sometimes attached to the frame of the spectacles, and another variety has a fine metal net around each glass. The openings of the net are, however, easily closed up either by rust or by dirt, and then the glasses are too heating. These glasses are chiefly of service to laborers working in dusty places or where there is danger of fine particles of iron or stone getting into the eye. Marble- or stone-cutters have to use them, especially if they suffer from blepharadenitis or conjunctivitis.

The curved glasses or coquilles afford, as a rule, the best protection, but they are very liable to produce the effect of a concave spherical, or sometimes of a concave cylindrical, lens, and are therefore liable to cause in emmetropic or hypermetropic eyes pain and irritation, and in some cases even dizziness. This is especially the case with the cheap ordinary glasses. The better kind, known as English driving-glasses, are, as a rule, free from this defect, but they are very expensive.

Next to the smoked or dark glasses, blue or green spectacles are most frequently used. Formerly, when it was thought that the yellow rays of light were the most irritating, green glasses, which excluded them especially, were recommended, but later investigations having proved that the orange rays are most irritating, blue glasses have been recommended. Glasses of these tints may be used in the shape of coquilles or plane glasses, and are especially useful in all cases of

choroiditis, iritis, phlyctenular keratitis, hyperæmia of the retina, and in slighter cases of conjunctivitis; whereas the dark or smoked glasses are very useful in all catarrhal inflammations of the conjunctiva, in ulcers of the cornea, and in iritis if the days are bright and sunny.

A faint tint of blue to concave or convex glasses is of great service to all patients who cannot bear bright light well, and for those who are much on the water or the sea-shore these lenses may be made with a faint smoke hue. A word of caution is, however, here not out of place, as some persons will so accustom their eyes to this subdued light by wearing dark-tinted glasses that they can hardly do without them thereafter. In-doors or on dark days they are not only useless, but they make vision more difficult, and should therefore not be used on such occasions.

The most common form of protection from the bright light to diseased eyes is to darken the room. Formerly this was considered of greater importance than now, as we have learned to appreciate the fact that very often the patients who dread the light most are those who need it for their general welfare.

After operations patients are frequently placed in dark rooms, usually for a short time only. This not only prevents irritation of the sound eye, but it excludes all possibility of using it, and thus ensures more complete rest for both eyes, especially, however, for the eye which has been operated upon. This had been carried to such an extreme that after important operations—such as for cataract—the patients were put into a very dark room, although both of their eyes were firmly bandaged. This is, however, hardly necessary if one takes the precaution to darken the room at the time the bandage is changed. A darkened room is very gratifying to nearly all eye patients, as there is in most cases of active inflammation of the eye a certain amount of photophobia; but this should not be carried too far, and especially not in children with a delicate constitution. These are, however, the ones to plead more for darkness than any other class of patients. A strumous child with phlyctenular conjunctivitis or keratitis cannot be brought into a light room without making it cry, and yet, after remaining in the light room, these patients soon become accustomed to the light, and their general health improves more rapidly: they should therefore be taken out into the fresh air as much as possible, even if they protest against it. Such children prefer to remain in darkened and, as a rule, poorly-ventilated bedrooms until late in the afternoon, and at night they venture in the street to play. A pair of dark glasses and plenty of fresh air are, however, of much more help to them than the darkened room. Formerly this was not fully appreciated, and not unfrequently do we hear adults say that when they were children they were kept in a darkened room

for six months at a time on account of sore eyes. There is one form of keratitis, however, in which it is difficult to get the patient accustomed to light, and this is the diffuse or interstitial variety due to inherited syphilis. In the severer forms, which are associated with joint affections, a dark room may have to be provided for the patients, but in the great majority of cases they will be enabled to be out-doors, especially if eserine is used in place of atropine, and dark glasses are provided. Artificial light, as a rule, is more irritating than daylight, as it contains more orange rays. It has to be excluded, therefore, as much as possible.

There are glasses made of crystal which are so thick and durable that they are considered even shot-proof. If it were not on account of the cost, all men, especially those who have only one eye, who work in places where there is danger from flying pieces of steel or stone should be provided with them. Nurses having charge of patients with purulent diseases of the conjunctiva should have their eyes protected by large coquilles of white glass, in order to prevent any of the discharge being thrown into their eyes at the time of cleaning the diseased eye.

Local anæsthetics are of very great importance in ophthalmology. The most important of all these is the active principle of *Erythroxylon coca*, which is known as cocaine. Discovered by Dr. Koller, now of New York City, as an anæsthetic to the cornea and conjunctiva, and in a lesser degree to the iris, its use has not only been a great boon to humanity, but it has made the study of ophthalmology much easier and pleasanter than formerly. Its use enables us to make strong caustic applications to the eye without suffering to the patient; it enables us to perform operations upon the eye with the dangerous complications reduced to a minimum; it dilates a contracted pupil, and enables us to study the interior of the eye without the slightest inconvenience to the patient. Cocaine may be obtained in the shape of fine crystals, in an amorphous state, and in solution. The latter usually contains 4 per cent. of cocaine, and may be used in its full strength or more or less diluted. The solution keeps very well, but when fungoid growths are observed in it it should not be applied to the eye, as it is then liable to cause a good deal of irritation of the conjunctiva, and will in some individuals set up quite a severe conjunctivitis. There are, however, patients who do not bear even the purest solution of cocaine well. It seems to poison the eye, exciting a conjunctivitis and an eczematous condition of the lids which is characterized by profuse lachrymation, intense itching, and burning of the lids, and even by severe pain in the lids and conjunctiva. In some persons instillations of cocaine into the conjunctival sac, especially if this is done repeatedly —as for operative purposes—will produce constitutional symptoms of

an alarming kind. These may show themselves by a very excited condition of the patient, by palpitation of the heart, by vomiting, or by great irritability of the bladder, or even of the rectum.

In order to reduce these dangers to a minimum the hydrochlorate of cocaine should be employed in the crystallized shape: it should be dissolved at the time it is to be used, and the solutions for ordinary purposes should not exceed the strength of 2 per cent. This strength may be greatly increased if the solution is to be used for operative purposes in badly-inflamed eyes. Amorphous cocaine is apt to be hygroscopic, and it is liable to be painful even if applied in solution.

For operative purposes on the lids the instillations into the conjunctival sac will hardly be sufficient, and a 4 per cent. solution may be applied to the tissues by means of a hypodermic syringe. Its efficacy is greatly enhanced if the so-called lid forceps, such as Desman's or modifications of them, have previously been applied. Even extensive operations—such as for entropion or trichiasis—may be performed in this way with little or no pain to the patient.

The effect of cocaine appears to be especially prompt on the cornea. A few seconds after the use of very weak solutions of the drug the cornea is so anæsthetic that it can be touched or foreign bodies may be removed from it without the patient feeling the instrument used for this purpose. In order to render the use of such remedies as nitrate of silver or sulphate of copper painless the stronger solutions of cocaine—4 per cent., for instance—should be repeatedly dropped into the conjunctival sac for five or ten minutes preceding the application; and for operations on the iris or the external muscular apparatus the instillations of cocaine should be made from five to ten times in about ten minutes preceding the operation: even then the seizing of the iris by means of the forceps is apt to be felt a little by the patient. In the operation for advancement of a muscle a 4 to 8 per cent. solution of the drug should be dropped upon the exposed muscle after the conjunctival section has been made.

One of the greatest advantages of the use of cocaine in operating is its action upon the capillaries: they become contracted and the operation is rendered nearly bloodless. The patient, retaining his consciousness after its use, is able to assist the operator by moving the eyeball in any desired direction. The use of fixation forceps, which are liable to tear and bruise the conjunctiva, is therefore not often called for.

In operating for obstructions of the lachrymal passages its use is of less value, as it lessens only the pain of dividing the canaliculi: it has not the slightest effect upon the constricted portion of the lachrymal canal. Even in the introduction of lachrymal probes it is of little value unless it is injected into the lachrymal sac by means of a small syringe with a bent point, which is to be introduced into the sac by

way of the divided canaliculus. The solution should, however, in this case be used carefully and sparingly, as it is readily absorbed, and may then give rise to constitutional disturbances.

There is one effect of cocaine upon the eye that must never be lost sight of, and this is its action upon the epithelium of the cornea. Not only does this become dry after the use of cocaine, but it may necrose to a certain extent and be lost. In order to avoid this the eyes should be kept closed during the intervals of dropping in the cocaine. This precaution seems to be called for especially in cataract extractions when the bichloride of mercury is to be used as an antiseptic. The epithelial layer may be lifted up like a vesicle, and extensive opacities of the cornea have been known to form in this way.

Another peculiarity is the staring appearance of the eye after the use of cocaine. This is due to its effect upon the unstriped muscular fibres of Müller of the upper lid, which are stimulated to marked contraction, thus raising the upper lid considerably. This effect of the drug varies in different individuals, but it is, as a rule, so marked as to cause a great difference between the cocainized and the other eye, and may appear as a great deformity. In order to avoid this, as well as the difference of the size of the pupils of both eyes, a small quantity of the drug should be applied to the other eye at the time that its use is called for: especially in women this precaution should never be forgotten. On account of its ability to cause elevation of the upper lids the use of this remedy may be necessary for some forms of ptosis, on account of the cosmetic effect obtained. This holds true especially in all cases of false ptosis after inflammations of the lids or conjunctiva, and in cases of congenital ptosis. Triturations or gelatin disks containing a very small percentage of cocaine are especially useful for this purpose.

Another drug which possesses marked anæsthetic properties is the alkaloid called strophanthin, which is obtained from the South African plant *Strophanthus prunatifolius*. The attention of the profession was called to this drug only a few years ago, but it seems to be so irritating to the conjunctiva that its use will never become as popular as that of cocaine, nor is its action as prompt as that of the latter drug. It takes nearly fifteen minutes for the physiological effect to be felt, but the cornea remains anæsthetic for nearly two hours afterward. Like cocaine, its action is less marked on the inflamed tissues of the eye.

Other drugs which have an anæsthetic affect upon the conjunctiva, though to a lesser degree, are hydrocyanic acid, especially useful in the form of cherry-laurel water, and the essential oils of fennel, anise, and rose. They are all used in the form of watery solutions, and are employed as vehicles for astringent remedies in collyria.

Hamamelis is a favorite popular anæsthetic, best used in the form

of the distilled fluid extract, and certainly possesses soothing properties which in simple hyperæmia of the lids and conjunctiva give great relief. Its effect is, however, very evanescent. It may be used in the ordinary strength applied to the eyelids, or diluted with several parts of water it may be used as an eye-lotion and applied to the conjunctival sac by allowing a few drops of it to get into the eye, or it may be diluted with about 10 parts of water and used by means of an eye-bath. The fluid also possesses mild antiseptic properties. Infusions of poppyheads and watery solutions of opium are frequently employed, the former in the shape of hot fomentations, the latter as additions to eye-lotions containing remedies which are liable to cause pain.

An infusion of tea-leaves is another popular remedy. Its use is agreeable and harmless in the milder forms of conjunctivitis. In inflammations of the cornea it should be used as hot as the patient can bear it. Poulticing of the eye with tea-leaves cannot, however, be too strongly condemned, as it may aggravate an ordinary conjunctivitis and lead to infiltration, and even to ulceration, of the cornea.

The German chamomile (*Matricaria chamomillæ*) enjoys a great reputation as an anodyne in eye diseases, and especially a hot infusion prepared by throwing a table-spoonful of the flowers into a quart of boiling water, allowing it to stand in a hot place for fifteen minutes, and straining it before it is used. The action of atropine and other mydriatics as anodynes, especially in iritis and keratitis, is generally known.

Cold is a local anæsthetic of great service in some forms of keratitis associated with intense dread of light. In children especially it may be used by allowing cold water to drop from a large piece of ice upon the exposed cornea; this may be kept up for half an hour several times a day. In severe forms of irritation of the conjunctiva—as, for instance, after the entrance of irritating substances into the eye or in cases of simple hyperæmia due to the irritating effect of dry or bad air—a small piece of ice held to the eye will give great relief. In severe forms of conjunctivitis cold is usually employed in the form of iced compresses.

Heat is of great value in painful attacks of keratitis or iritis. It is employed in the form of hot compresses or by allowing steam, especially of aromatic infusions, such as the German chamomile, to enter the eye.

General Anæsthetics have lost much of their importance for the ophthalmic surgeon, as local anæsthetics have taken their place to a great extent. However, there are cases in which it becomes necessary to resort to their use on account of the nervous condition of the patient. It is absolutely necessary that in the more delicate operations upon the

eye the patients should keep perfectly quiet and not interfere with the operator. Where this is impossible some general anæsthetic will have to be administered. Again, their use may be indicated for the purpose of making a diagnosis in cases of painfully inflamed eyes of children, or even of adults, where cocaine is rendered insufficient by the inflamed condition of the parts or after extensive injuries of the eyes. Likewise in all cases in which the magnet has to be used for the removal of foreign bodies from the vitreous humor or from the posterior tunics of the eye the use of ether or chloroform is indicated. In very young children for examination of the eye, as well as for nearly all other operations, the use of chloroform is to be recommended, because, as a rule, a few drops of the anæsthetic suffice to produce complete anæsthesia of the patients, and because the effect of it upon infants is very slight, not even nausea being produced. Taking the child's head between the knees or placing the child on the operating-table, the operator puts a few drops of chloroform on a towel and holds it loosely over the patient's mouth: he will be able to overcome even the severest blepharospasm in a few seconds, make a careful examination of the cornea and other parts of the eye, or do any little operation, and have the child thoroughly aroused again in a few minutes. In administering ether a self-made cone or an apparatus for inhaling it is necessary. However, as nearly all operations upon the eye can be done in a very short time, frequently in less than one or two minutes, it is not necessary to give enough ether to induce profound anæsthesia. It is generally sufficient to produce only the primary effect of the drug. The great difficulty of the anæsthetic is, however, the intolerable nausea and vomiting which follow the recovery to consciousness, or which may set in during the operation and interfere greatly with the work of the operator, adding new dangers in the possibility of impure matter getting into the eye, increasing the time of exposure, thus enabling bacteria to infect the wound, and causing unnecessary delay. If, therefore, profound anæsthesia is desired in order to perform operations upon the eye, enough of the anæsthetic should be given at once, and the patient should be kept so thoroughly under its influence that no vomiting nor any movement of the patient during the time of the operation is possible. The anæsthesia should be kept up until the wound and the conjunctival sac have been thoroughly cleansed and disinfected and the parts properly bandaged—in fact, until the operation has been entirely finished.

For minor operations of short duration, or for patients who on account of heart or renal diseases cannot take a general anæsthetic without running great risk, or for patients who have a great prejudice against the employment of either ether or chloroform, the use of nitrous oxide is highly to be recommended. It

is generally easily procured from a dentist, or it may even be administered by an experienced dentist in the house of the patient. Should its effect be too evanescent, the gas may be followed by the use of either ether or chloroform with perfect safety. This gas is safer than chloroform, and its after effects (congestion of head and face) are not so marked as those of ether. The usual precautions, such as having amyl nitrite or an electric battery near by, should, however, never be neglected, and in case the patient is in distress he should be allowed to inhale a little pure air: the tongue should be seized and drawn forward, the mouth and nose should be kept as free from mucus as possible, and the patient's head should be lowered promptly as soon as any dangerous symptoms manifest themselves. In cases of very profound and dangerous anæsthesia the intense dilatation of the pupil, which is apt to indicate this condition, can be readily observed by the operator, and should never be overlooked by him, as he has the eyes constantly before him while he is operating.

Mydriatics.—A dilatation of the pupil beyond the normal state, and the more or less complete inability of the sphincter to counteract it, is called mydriasis. This condition is either the result of paralysis of the sphincter muscle of the iris, or rather the nerve supplying it, or is caused by the action of drugs which, instilled into the conjunctival sac, reach the iris by endosmosis through the cornea. Their use is therefore called for when a patient has a narrow pupil in order to dilate it, and thus enable the observer to examine the interior of the eye, and especially in order to examine the periphery of the lens, which under ordinary circumstances is more or less completely hidden by the iris. These drugs are likewise used to dilate the pupil if there is danger that the pupillary margin of the iris may become adherent to the centre of the lens, or to break up such adhesions if they have formed. They are also of great value in nearly all forms of keratitis and to produce complete rest of the eye, as they exert not only a paralyzing effect upon the sphincter muscle of the iris, but also upon the ciliary muscle, the muscle of accommodation. After the use of such a remedy the patient cannot use his eyes for near objects, and, as accommodation is entirely done away with, the true state of refraction of an eye can now be readily determined; and it is for this purpose that these drugs are frequently employed.

The drugs which have this peculiar property of dilating the pupil are called *mydriatics*. They act by paralyzing the third or motor oculi nerve, which supplies the sphincter muscle of the iris, and by exerting at the same time an irritating effect upon the sympathetic nerve-fibres, which go likewise to the iris; for even after paralysis of the sphincter iridis, which is characterized by dilatation of the pupil to a moderate degree, the mydriasis will become more complete after the use of a

mydriatic. In fact, one of the diagnostic signs of mydriasis caused by drugs of this kind is the extreme dilatation produced, whereas the mydriasis of paralysis of the third nerve is perhaps only two-thirds of the former, which may amount to a dilatation with a diameter of 8 mm., whereas that of a paralytic mydriasis amounts rarely to more than 6 or 7 mm.

The great majority of the drugs called mydriatics are poisonous and are derived from plants belonging to the family of Solanaceæ. The most important of these is *Atropa belladonna*, containing the alkaloid atropine. Its use is quite ancient, and, as its name implies, it has long been known to the fair sex for its beautifying effect upon the eyes. Several of the mydriatics, however, have been only recently brought to our notice, such as duboisine, cocaine, and hyoscine, for instance. The number of this class of remedies is much greater than that of those which have an opposite effect, contracting the pupil, and which are called myotics. Belladonna and its principal alkaloid atropine or its salts, especially the sulphate, are the most powerful and most frequently used of mydriatics.

Belladonna may be used in the form of a solution of an extract of the leaves of the plant. Although at present the use of the extract is almost entirely superseded as a mydriatic by a solution of its principal alkaloid, atropine, yet there are persons in whom the alkaloid has an irritating and poisonous effect, who can, however, use a recently-prepared solution of the extract of belladonna with impunity. The following prescription may be used:

℞. Extr. bellad. aqueous., gr. xx;
Aquæ destillatæ, ℥ss.—M.
Ft. solutio et filtra.
Sig. Apply two to three drops to the eye every three hours.

Of the alkaloids the sulphate of atropine is usually employed. We may use the pure alkaloid, but it is hard to dissolve, and in order to make a clear solution a few drops of an acid should be added, which, if not entirely neutralized, will have an irritating effect upon the eye. According to the requirements a more or less powerful solution may be ordered. The strength of the solution usually employed is as follows:

℞. Atropinæ sulphatis, gr. j;
Aquæ destillatæ, ℥ss.—M.

This equals 2 grains of atropine to 1 ounce of water: it may be used two or three times a day, 1 or 2 drops being instilled into the conjunctival sac at a time. This will suffice in all cases of ordinary keratitis

and in most cases of iritis, and likewise to paralyze acommodation for the purpose of determining the existing error of refraction or for the purpose of making an ophthalmoscopic examination of the interior of the eye. In severer cases of iritis, however, a much stronger solution of atropine may be employed in order to break up firm adhesions of the iris, and if there is much spasm of accommodation this stronger solution of atropine may likewise be required. As a rule, a solution of 4 grains of sulphate of atropine to 1 ounce of water will be sufficient, but in severe cases of irido-cyclitis, as they occur at times after cataract extractions, even a solution of 8 grains of atropine to 1 ounce of water may be used. It is better, however, not to entrust such powerful solutions of this poisonous drug to the patient or to ignorant attendants: they should be used by the physician himself at the time of the visits of the patient, or they may be entrusted to a careful nurse. In using atropine on patients who are easily poisoned by it, poisoning being shown by a dryness of the throat, bitter taste, and redness of face and neck, and especially if using very strong solutions of the alkaloid, it is well to direct the patient to bend the head to the side of the external canthus of the eye affected, and to exert gentle pressure on the tear-sac by means of the finger for some time after the instillation has been made, until it is almost certain that most of the drug has been absorbed or has been washed out of the eye by the tear-fluid. If an eye is badly inflamed and the vessels intensely engorged, the action of the drug is sometimes very much delayed and diminished. In these cases it is well to precede the use of atropine by the application of a little cocaine, or by applying a couple of leeches to the temporal region of the affected eye, or by using hot fomentations for ten or fifteen minutes. Of course the use of cocaine is, as a rule, most convenient and efficient, but leeches are of great value to deplete the engorged blood-vessels, and will thus exert at the same time a beneficial effect upon the inflamed eye.

Atropine mydriasis is produced within ten or fifteen minutes after the instillation of the drug, and the maximum dilatation is obtained in about one hour. The effect of the drug is felt at first by the iris, and later by the ciliary muscle; it lasts from ten to fifteen days, according to the quantity of the drug used and the susceptibility of the patient, for this varies in different persons, and is especially marked in hypermetropic, less so in emmetropic, and least of all in myopic, patients. Although the accommodation remains affected for a longer period, yet the patients are, as a rule, able to read large print, and may even be able to write, in about six to ten days after the use of the drug has been discontinued. Atropine should be used with some care, and never without informing the patient of its effect, as great inconvenience may be experienced by the inability to use the eyes for reading or writing

for such a long time. The tendency of the drug to cause symptoms of severe poisoning, and even hallucinations, has been spoken of: there is likewise the peculiarity of its setting up a severe form of conjunctivitis with œdema and erythema of the lids; in these cases another mydriatic must be used in its place. In young infants, or even in children seven to eight years old, its use is sometimes followed by the appearance of a bright-red rash, which, making its appearance several minutes after the instillation of the drug, may spread from face and neck rapidly over the entire body, and, as it is apt to be accompanied by a slightly feverish condition and sometimes by restlessness or drowsiness, it has often frightened the parents or friends of the child, who think that an attack of erysipelas or scarlatina has made its appearance. This form of atropine erythema will pass off within a few hours after the use of the drug, and is liable to make its appearance every time atropine is instilled into the eye, even if all the precautions to prevent its absorption have been used and fresh and sterilized solutions are employed.

The long-continued use of atropine is liable to set up a very annoying form of conjunctivitis, with great prominence of the papillary layer, which may require the use of powerful astringents for its cure, and may make the discontinuance of the mydriatic necessary.

In very old persons mental disturbances, such as hallucinations and irrational talk, are liable to follow the use of strong solutions of atropine: this fact should not be lost sight of if such old persons have a small and rigid and perhaps not easily dilatable pupil, when, therefore, much atropine may be needed. In old persons there is another danger in the use of atropine in the fact that the disturbance of circulation, and especially that of filtration into the canal of Schlemm, the iris being crowded into the angle of the anterior chamber, may lead to the development of glaucoma. This may show itself in a very short time, perhaps in less than half an hour, after the instillation of the atropine solution if the patients are predisposed to the disease; sometimes it does not develop until the second or third day. As this holds true in all cases where mydriatics are employed, their use should be preceded by testing the tension of the patient's eye or by inquiry for any premonitory symptoms of glaucoma, such as temporary obscuration of vision and the appearance of colors of the rainbow when looking at a light.

Next in importance to atropine as a mydriatic—not in regard to its power, however, but more because it can be used without inconvenience—comes the hydrochlorate of cocaine, which is the alkaloid of *Erythroxylon coca:* it may be used in the following strength:

℞. Cocain. muriat.,	gr. x;
Aquæ,	ʒss.

One or two drops of this solution will, as a rule, produce a moderate amount of mydriasis in about fifteen minutes. As the mydriatic effect of cocaine is not very great, it is of very little value to prevent the formation of adhesions in iritis or in the breaking up of posterior synechiæ if the adhesions have already formed; and as it has no effect upon accommodation, it is likewise of little help in determining the state of refraction; but it is of great value in making ophthalmoscopic examination if the pupil of the patient is a little narrow or if the observer is not a very experienced ophthalmoscopist, or when it becomes necessary to examine the more peripheral parts of the patient's lenses for suspected opacities, or the periphery of the choroid and retina for hæmorrhages and other morbid changes. The only drawback to the use of cocaine for this purpose is the fact that strong lights diminish the dilatation of the pupil, and that only a moderate amount of light can be employed for such examination. This is, however, not the case in mydriasis produced by atropine, light having no effect whatever upon it. The great value of cocaine as a mydriatic is that it does not interfere with the occupation of the patient, it having no effect upon the accommodation, and the patient may be tested for reading-glasses immediately after its use; moreover, the dilatation remains perceptible only for twenty-four hours or even less. Its use, if only one eye is to be examined, may be extended to the fellow-eye for cosmetic effect. It will not inconvenience the patient, and the deformity of having one pupil large, and even the eye itself apparently enlarged and staring by the retraction of the upper eyelid, is avoided in this way. However mild and harmless its use ordinarily is, yet cases have been reported where an attack of glaucoma was apparently ushered in by the instillation of cocaine; and the possibility of this result should always be remembered when it is used very freely on old patients.

Duboisine is a very powerful mydriatic derived from *Duboisia myoparoides*, a plant found in Australia and in the southern parts of Africa. It was introduced in 1878. It is characterized by its prompt and energetic effect upon the iris, and is therefore of great value in breaking up old and firm adhesions of this organ to the lens. It may be used in the same strength as atropine, but great caution should be exercised to prevent the absorption of the remedy by the mucous membranes, as it is a more poisonous drug than atropine, and cases of acute mania and great prostation have been seen to follow its use, these symptoms sometimes appearing at the time of the visit of the patient to the doctor's office; which is very embarrassing, to say the least.

Duboisine is very useful for determining the refractive condition of an eye, as it paralyzes the accommodation promptly, and because

its effect upon the ciliary muscle is not very lasting, passing off, as a rule, in about six or seven days. As its use is not frequently required, it should not be kept in watery solution, which spoils very easily: the better way is to keep it in the form of gelatin disks or as a trituration.

Duboisine may sometimes be employed with safety when atropine is liable to set up conjunctivitis or irritation of the integument of the lids. Like atropine and other mydriatics, its internal use, especially when given in poisonous doses, will cause mydriasis and paralysis of accommodation.

Homatropine hydrobromate is one of the more recently introduced mydriatics: it has been known since 1879. Its mydriatic effect is not so powerful as that of atropine, although it is derived from the same plant; but its effect upon the ciliary muscle is quite marked, and paralysis of accommodation is produced in most cases in about half an hour after its use. The remedy recommends itself, therefore, for the purpose of determining the refraction of eyes, especially as the paralyzing effect will pass off in two or three days.

This drug may be employed in the shape of gelatin disks, in triturations, or in a solution containing 4 grains of the alkaloid to 1 ounce of water. Two or three drops of the solution may be put into the conjunctival sac two or three times at intervals of from five to ten minutes or until complete paralysis of the accommodation is produced. The remedy possesses little value in inflammation of the iris or cornea. A trituration may be made by mixing it with equal parts of sugar of milk until it is reduced to a very fine powder, of which a small quantity is to be dusted upon the conjunctiva of the lower lid.

Daturine, the principal alkaloid of *Datura stramonium*, was formerly much employed as a substitute for atropine, and, in fact, it is frequently used to adulterate atropine with, as it is more easily procured than that drug. It is, however, not nearly so reliable a mydriatic as the former, although isomeric with it, and as there are better substitutes for atropine, it is used very little at present. It may be used in solutions, 4 grains to 1 ounce of water, and employed in the same way as atropine. Its constitutional effects are not so easily produced, and it may be considered a safe remedy.

Hyoscyamus niger furnishes us with two alkaloids with mydriatic properties. They are *hyoscyamine sulphate* and *hyoscine*. The former has been known a long time, has been used sometimes as a substitute for atropine, and is of about the same strength and composition; it may be used in the same manner as daturine.

Hyoscine is usually employed in the form of the hydrochlorate: it is much more powerful than hyoscyamine, and may produce very

quickly alarming constitutional symptoms. After using a few drops of a 2-grain solution, if no extraordinary precautions have been taken it is liable to cause a dry throat, marked dizziness and nausea, and even vomiting. Although it has a very powerful effect in breaking up old adhesions of the iris, its use must always be a limited one, on account of its poisonous properties. For determining the refraction of the eye it is of no greater value than more harmless remedies, such as homatropine.

The symptoms of poisoning after the use of mydriatics manifest themselves usually in the following manner: At first there is a bitter taste with dryness of the throat and parched condition of the tongue; this is followed by dyspnœa and a quick but feeble pulse, frequently by redness of the face and even of the body, a sense of fatigue, more or less nausea, frequent micturition, and more or less violent delirium. As antidotes we have to depend principally upon stimulants, such as brandy and digitalis, and opiates, especially paregoric or morphine. In severe cases hypodermic injections of $\frac{1}{6}$ grain of muriate of pilocarpine may be given.

Myotics.—A narrow condition of the pupil is known as myosis. It is not infrequently a sign of disturbance of the general system, and especially in spinal affections the pupil may become very small, and is then spoken of as a pin-hole pupil. It is likewise observed as a sign of reflex irritation of the third or motor oculi nerve, and as such it may have its origin in cerebral or spinal disturbances; and it may be entirely due to peripheral irritation, such, for instance, as the presence of a foreign body on the cornea or in the conjunctival sac. However, a narrowing of the pupil may be due to medicinal agents which are known under the name of myotics. The variety of this class of drugs is not so great as that of the mydriatics, to which they may be considered as exactly opposite in their action, as one class will counteract the other and will serve as antidotes in poisoning cases. The latter are, however, more lasting in their effects, and although a myotic may counteract a mydriatic and cause contraction of a dilated pupil due to the mydriatic action of such remedies, yet the contraction will not last more than twenty-four hours under any circumstances, and then the action of the mydriatic, with the exception of cocaine, will make itself felt again, and the pupil will dilate and remain dilated, as if the myotic had never been used. As the principal effect of a myotic is due to irritation of the nerve-fibres, and not, like that of a mydriatic, to paralysis, although there is a paralytic effect upon the sympathetic nerve, its use is generally followed by some pain, beginning shortly after its application and continuing, according to the strength of the drug, from five to twenty minutes, causing at the same time a sensation of dragging and pulling of the muscles of the iris, and not unfrequently twitching of

the eyelids. The use of myotics is not so annoying as that of the mydriatics, as they merely cause a spasm of accommodation and approach the near and far point: there is not much impairment of vision, neither for near nor for distance. On account of their irritating effect upon the iris strong solutions of these drugs may lead to a mild degree of iritis, and firm posterior synechiæ may be not infrequently seen if they are used in too concentrated a form: their use is therefore contraindicated whenever there is a tendency to iritis, and especially in old people very weak solutions must be used. These remedies are useful in some forms of keratitis, especially those which are usually met with in childhood, such as the phlyctenular or the parenchymatous variety, and in the vascular form of the disease. They are likewise very useful in the ulcerations of the cornea accompanying blennorrhœic conjunctivitis of the newborn. In deep peripheral ulcers of the cornea, where there is the slightest danger of a perforation, their use becomes necessary in order to prevent incarceration of the pupillary border of the iris in the wound. This is perhaps the only case where the use of a strong solution is indicated. In serpiginous ulcers of the cornea their use is very beneficial, but as this disease affects generally people of mature age, the solutions must be mild. After cataract extractions, especially in those without an iridectomy, myotics are used in order to prevent the incarceration of the iris in the wound.

However, it is especially in glaucomatous cases that the use of a myotic is imperatively indicated, particularly if an iridectomy cannot be made at the time. A mydriatic has the tendency to obstruct the iris angle, and thus incite a glaucomatous attack. A myotic, on the other hand, by contracting the pupil stretches the iris and draws it away from the dangerous region, making percolation into the canal of Schlemm easier, and at the same time permits the fluids of the posterior portion of the eye to pass through the stretched tissues of the iris very readily. It is in this way that the use of a myotic influences osmotic action in the eye and diminishes the intraocular tension. The use of these drugs is especially beneficial in the more chronic forms of glaucoma.

Myotics, if used for any length of time, are liable to cause much irritation of the conjunctiva, affecting particularly the epithelial and papillary layer, causing swelling and exuberant development of it, the treatment of which is sometimes very troublesome and tedious. It is hardly necessary, perhaps, to add that old persons are more liable to suffer from the irritating effect of these drugs than children. This may become very annoying, as glaucoma attacks almost exclusively older people, where the remedies may have to be used for many months continuously. By using only fresh solutions and adding

boric acid to them, from 10 to 20 grains per ounce, or by mixing the drugs with vaseline, this annoying complication can be avoided to some extent.

Myotics have to be used at times to counteract the effect of mydriatics: if after the accidental use of mydriatics or after examinations for refractive errors the dilatation of the pupil is not only annoying, but seriously interferes with the avocation of the patient, the employment of myotics is called for.

The list of myotics is as follows: Extract of Calabar bean, physostigmine or eserine, pilocarpine, and muscarine. Opium, morphine, aconite, and veratrum have likewise myotic properties, but they cannot very well be used locally, and if given internally it is some time before they cause contraction of the pupil, nor is the myosis very marked. However, the condition of the pupil after an overdose of these drugs, as in cases of opium- and morphine-poisoning, is of great diagnostic value, especially if the patient is in a comatose condition.

A watery solution of the extract of Calabar bean (*Physostigma venenosa*) is the remedy which was formerly exclusively used as a myotic, but it has been superseded by eserine and pilocarpine. Twenty grains of the extract are to be carefully dissolved in 1 ounce of warm distilled water and filtered, when it is ready for use: 1 to 2 drops of the solution may be used three times a day. This plant is used by the natives of the west coast of Africa as an ordeal poison. Its principal ingredient is an alkaloid called *physostigmine* by chemists and *eserine* by physicians. This remedy may be used in the form of the sulphate or salicylate in solutions of 1 to 2 grains to 1 ounce of distilled water. It appears that the salicylate is less irritating to the conjunctiva than the sulphate, and it should be selected in all cases where the remedy has to be continued for any length of time. The solution, which has, if quite fresh, a faint pinkish tint, will gradually become darker until it has at last a brownish-red appearance. Its usefulness does not appear to be diminished by these changes: it becomes, however, slightly more irritating to the eye if very old. It should, therefore, be frequently replaced by fresh solutions. The triturations or gelatin disks of eserine are very reliable, and may be used in place of the watery solutions:

℞. Eserinæ salicyl., gr. ss;
Aquæ destillata, ℥j.
Sig. Two drops in eye three times a day.

This is 1 part of the salt to 1000 parts of water, which is usually sufficient, and yet perfectly safe. To counteract a mydriatic one application of 2 or 3 drops is usually sufficient.

The poisonous effects of eserine manifest themselves by nausea and vomiting, accompanied at first by a rapid pulse, which, however, soon becomes slow and weak, and this is followed by weakness and dyspnœa. However, there is little danger if only weak solutions are used. As antidotes, atropine hypodermically, brandy, artificial respiration, and electricity are called for.

Pilocarpine is an alkaloid obtained from the jaborandi-leaves (*Pilocarpus pennatifolius*). It is seldom used as a myotic, but it may be employed for this purpose by dissolving 4 grains in 1 ounce of distilled water, applying it about three times a day. As a rule, it is given by the mouth or by hypodermic injections, which are usually made in the temporal region. Its use is sometimes followed by great nervousness, retardation of the pulse, and a sense of suffocation. From $\frac{1}{20}$ to $\frac{1}{15}$ grain will usually suffice, although in cases of detachment of the retina of recent origin it may be used in doses of $\frac{1}{10}$ or $\frac{1}{5}$ grain. In chronic cases, or where the remedy is to be continued for any length of time, $\frac{1}{100}$ grain three times a day is sufficient, especially at the beginning of treatment.

Another myotic is muscarine, the alkaloid of *Amanita muscaria*. It has the peculiarity of affecting the ciliary muscle especially, and the sphincter of the iris to a lesser degree. Its action is therefore to cause a strong spasm of accommodation, and to affect the far point of the eye principally.

About the administration and use of myotics like quinine, aconite, etc. it is hardly necessary to speak here, as they affect the eye only secondarily after internal use.

Collyria.—Eye-lotions are usually employed in two forms—the one to drop into the conjunctival sac, the other as a wash for bathing the lids: the latter is to be applied to the lids only if it is intended to medicate the lids or the margin of lids, as, for instance, in blepharadenitis or in eczema. At the same time some of the wash should be allowed to get into the conjunctival sac, either by opening the lids at the time of applying it or by dropping a few minims of the wash from a dropper or from a tea-spoon into the eye, or by using it in a so-called eye-cup: this is filled and placed over the lids, which are now to be opened and closed, thus allowing the conjunctival sac to be washed out thoroughly. The lotions used for this purpose must therefore be considerably weaker than drops, of which only a small quantity is allowed to go into the conjunctival sac. For the purpose of treating an inflamed condition of the lids, for instance, a mild solution of borax (borate of sodium) or of bicarbonate of sodium may be employed by dissolving half a tea-spoonful, corresponding to about 30 grains, of the drug in a pint of water, which should have nearly the same temperature as the body—say, from 80° to 85° F. Liquor plumbi subacetatis may be employed for the same

purpose, adding about 4 drops of it to 4 ounces of tepid water. If the lotion is to be used directly to the conjunctiva and eyeball, and especially if there is much conjunctivitis present, the temperature should be considerably lower than that of the body, perhaps from 55° to 65° F. One of the most popular remedies for this purpose is alum. The variety known as potash alum is preferable to the ordinary ammonia alum. One tea-spoonful, corresponding to about 1 drachm, is to be dissolved in a pint of water and used to the eye three or four times a day. Sugar of lead may be employed in the same manner by adding only half a tea-spoonful of it, which will weigh about 1 drachm, to a pint of water. However, the use of this remedy—in fact, of all collyria containing any preparation of lead—should not be encouraged, as their indiscriminate use may, in case ulcerations of the cornea should be present, tend to serious complications, as the lead may become deposited in the ulcer and cause the formation of dense white opacities of the cornea, which, if centrally located, may even lead to blindness of the patient. Another popular though vulgar application to the eye, the use of which cannot be too strongly condemned, is warm urine for obstinate catarrhal inflammations of the eye. The employment of this dangerous fluid is, however, quite frequently resorted to by ignorant people, and gonorrhœal conjunctivitis, and not unfrequently the loss of an eye, has followed its use. Sulphate of zinc, in quantities enough to cover the point of a knife—about 10 grains—to a pint of water, is another popular eye-lotion; but it is safer to use all preparations of zinc in solution, which can be dropped into the conjunctival sac, as the dose can be regulated much better in this way. In fact, the use of eye-washes of this kind is very crude and unscientific, and should only be resorted to if the patient cannot have the drops applied to his eyes by a nurse or friend or if he cannot do it himself.

Collyria are popularly called "eye-drops:" they are to be divided into astringent, anodyne or soothing, stimulating, and caustic or irritating. Anything of a fluid nature which is to go into the eye should, in the first place, be perfectly clean: mechanical and especially fungoid impurities should be carefully avoided. The first object is obtained by filtering the solutions and keeping them carefully corked; the second, by having the preparations as fresh as possible, by excluding the air and the spores it contains, and by keeping the pipette or dropper which is brought in contact with the fluid as clean as possible. A dropper which is known in the drug trade as Barnes' eye-dropper cannot be too highly recommended here, because, as its rubber end acts as a cork, the air is excluded, and as the glass part of it is constantly inside the bottle in contact with the fluid, all danger of impurities is avoided. It is likewise important for the comfort of the patient that

the drops should not be too cold. It must not be forgotten that many chemicals change or are decomposed by the effects of light and heat: these preparations should therefore be kept in a dark and cool place, but may be heated, especially in winter, by holding the bottle containing them in warm water for a short time. The practice of the druggists to dispense eye-drops in blue bottles is of great value, as it excludes the dangerous rays of light; but, unfortunately, it is very difficult to discover any sediment or other impurities which may be present on account of the darkness of the glass. The drops are employed by raising the upper lid, or better by drawing down the lower lid: the method is immaterial as long as they get into the conjunctival sac; but it is well to be careful not to let the fluid drop on the cornea, as this increases the pain which most eye-lotions are liable to cause. For sensitive patients it is well to use a few drops of a weak solution of cocaine to the eye a few minutes before the eye-drops are employed, as this will prevent all pain. Cocaine should never be added to the solutions, as, in the first place, it is likely to become decomposed by them, and, in the second place, the pain is felt almost immediately as soon as the drops are used, whereas the anodyne effect of cocaine is felt only in five minutes after its use. Exposure to bright light and to heat, as well as rubbing or tight, forcible closing of the lids, should be avoided, as it increases the pain and irritation caused by the collyria.

The best vehicle to be used for making collyria is distilled water, which should be as fresh as possible, as even distilled water may become full of fungi and other impurities if kept for any length of time. If distilled water cannot be obtained, it will be well to boil the water to be used. Aromatic waters, such as rose, camphor, and fennel-water, and likewise cherry-laurel water, which is very soothing, have been used a good deal for the preparation of eye-lotions. Rose-water is very popular in all cases of hyperæmia of the lids and in the milder forms of conjunctivitis: its use is, however, of very little value.

Mucilage of acacia or quince-seeds and the preparations of opium were formerly often added to collyria, but they are not much used at present.

Astringent collyria owe their virtue more to the antiseptic properties of the drugs which they contain than to their astringent properties. These lotions should never be used so strong as to cause much pain or irritation, which might give rise to infiltration of the cornea, and thus cause great impairment and even loss of sight. The mildest of all these remedies is a solution of *boric acid*. Although comparatively a new preparation, it is employed a great deal. Its use is not painful, nor is it followed by any unpleasant complication, but, unfortunately, it is not powerful enough to subdue the severe forms of inflam-

mations of the conjunctiva, it being more of an aseptic than an antiseptic preparation. On account of its blandness it may be used in all mild cases of conjunctivitis, even if corneal complications exist or if severe wounds of the lids or eyeball are present at the same time. A solution of 10 grains to 1 ounce of distilled water, or one of 20 grains—which is a concentrated solution—may be used, applying 5 or more drops several times a day. It is beneficial in simple hyperæmia of the conjunctiva, in the milder forms of catarrhal conjunctivitis, in phlyctenular conjunctivitis and keratitis, and in some forms of blepharadenitis.

In all similar cases the *borate of sodium* may be used, but it is a more powerful astringent, and causes a sensation of gravel in the eye; it is, however, not painful. It may be employed in the strength of 6 to 10 grains per ounce:

℞. Sodii boratis, gr. iv;
Aquæ lauro-cerasi, ʒss.—M.
Sig. Apply one to two drops to eye three times a day.

Or,

℞. Sodii boratis, gr. x;
Aquæ camphoræ, ʒj.—M.
Sig. Two drops in eye three times daily.

The bicarbonate of sodium is especially useful in mild forms of conjunctivitis accompanying inflammation of the edge of the lid:

℞. Sodii bicarbonatis, gr. iij;
Aquæ rosæ, ʒss.—M.
Sig. Two drops in eye three times daily.

A very useful addition to these lotions is mucilage of quince-seed, which is made by agitating a few kernels with an ounce of water and straining it through linen:

℞. Sodii boratis, ʒss;
Aquæ lauro-cerasi,
Mucil. cydonii, āā. ʒss;
Aquæ destillatæ, ʒiij.—M.
Sig. Apply to lids and conjunctiva several times a day.

The addition of glycerin is not pleasant to the eye. As it favors and increases the process of osmosis, it has been claimed that it may affect the nutrition of the lens, and it is used therefore in the treatment of lenticular opacities or incipient cataract:

℞. Acidi borici, gr. x;
Glycerini,
Aquæ destillatæ, āā. fʒii.—M.
Sig. Two drops in eye morning and evening, and rub the eyelids gently with the hand after using it.

Cadmium sulphate is quite an astringent, and is supposed to have a beneficial effect in clearing up corneal opacities, especially those resulting from smaller ulcers of the cornea:

℞. Cadmii sulphatis, gr. j;
Aquæ destillatæ, ʒss.—M.
Sig. Use one drop in eye every morning and evening.

Alum is a more powerful astringent and antiseptic remedy than the last. Its application is sometimes painful, and may therefore be preceded by the use of a little cocaine:

℞. Aluminis, gr. v;
Aquæ camphoræ, ʒj.—M.
Sig. One drop in eye three times a day.

It is especially useful in the later stages of catarrhal conjunctivitis and in the mild forms of granular lids.

The preparations of *zinc* usually employed for collyria are the sulphate and the acetate; the white oxide is employed in the form of ointments. The application of the sulphate is very old and popular, but its effect is almost harsh and quite painful—much more so than that of the acetate, which deserves to be better known than it is at present:

℞. Zinci acetatis, gr. j
Aquæ lauro-cerasi,
Aquæ destillatæ, āā. ʒiij.—M.
Sig. One drop in eye three times daily.

℞. Zinci sulphatis, gr. j;
Aquæ rosæ, ʒj.—M.
Sig. One drop morning and evening.

Or,

℞. Zinci sulphatis, gr. ij;
Aquæ fœniculi, ʒiv.—M.
Sig. Use three times a day in chronic catarrhal conjunctivitis.

Formerly these collyria were much more complex, and the prepara-

tions of opium were frequently used as anodynes in addition. The wine of opium and a tincture of opium made with Spanish saffron were the opiates usually employed:

℞. Zinci sulphatis, gr. j;
Vini opii, gtt. xxv;
Aquæ destillatæ, ℥j.
Sig. One drop in eye three times daily.

The old celebrated *collyrium adstringens luteum* of Graefe was made as follows:

℞. Camphoræ, gr. x;
Alcoholis, f℥j;
Ammonii chloridi, gr. xv;
Zinci sulphatis, gr. xxx;
Croci pulv. hispanici, gr. ij;
Aquæ destillatæ, f℥v.
Misce et filtra.
Sig. Use one drop morning and evening.

The preparations of mercury, especially the bichloride, were much used empirically long before their antiseptic power was understood. The bichloride is now used chiefly as a disinfecting lotion after operations and in severe purulent conjunctivitis; it can rarely be used in stronger solutions than 1 part to 5000 of water, but occasionally it may be increased to 1 part to 3000 of water, and in old cases of trachoma it may be used even as strong as 1 part in 250 or 500 parts of water. It is to be brushed over the everted lids every second or third day. The biniodide of mercury may be employed in the same proportions; if, however, used in the anterior chamber, it must be much milder, and Panas' solution contains 1 part of the biniodide to 20,000 parts of water: it must be previously dissolved in a few drops of alcohol or in boiling water.

A very powerful astringent is *tannin*. Its watery solutions are difficult to keep clear, and a solution of it in glycerin is to be preferred:

℞. Acidi tannici, gr. x;
Glycerini, ℥ss.
Sig. To be applied to the everted lids by means of a camel's-hair brush every one or two days.

This remedy is very useful in all the more chronic forms of conjunctivitis, especially if there is not much discharge and if there is much

papillary hypertrophy; but it is likewise very useful in the cicatricial stage of granular lids, especially in those cases which are accompanied by pannus. Tannin should, as a rule, be applied by the physician, who is able to evert the upper lid and regulate the application according to the amount of reaction produced: it is, however, perfectly safe to let the patient drop a little of it into the conjunctival sac once a day; especially is this the case in the chronic forms of conjunctival affections. In such cases the amount of tannin may be increased to 10 per cent., or 40 grains to 1 ounce of glycerin.

One of the most powerful antiseptic, astringent, and stimulating remedies, and at the same time one of the most extensively used, is *nitrate of silver*. This is the *lapis infernalis* of the old writers, and it may be inferred from this name that its use is not only very old, but also painful. Solutions of considerable strength, such as from 5 to 20 grains to the ounce, are used: they act almost as an escharotic, and by destroying the superficial epithelial cells they kill at the same time all the microbes they come in contact with. On this account it has been used in the eyes of new-born children for the purpose of destroying all the bacilli which might have entered the conjunctival sac during the time of the passage of the child's head through the vagina. Crédé's fluid, which is usually employed for this purpose, is—

℞. Argenti nitratis, gr. x;
Aquæ destillatæ, f℥j. —M.
Sig. One or two drops to be applied to the eye by allowing them to fall from a small glass rod directly into the palpebral fissure.

The slight irritation following the use of these drops may be allayed by washing the eye with a boric-acid solution; as a rule, however, this will pass off without this. The stronger solutions of this drug should not be used in the onset of a conjunctivitis, but as soon as a discharge shows itself; and the more profuse the discharge the stronger should be the solution. Nitrate of silver should be used by the physician only, as an inconsiderate use might lead to corneal complications. The long-continued employment will often discolor the conjunctiva, that of the eyeball as well as of the lids, giving it a bluish-black appearance, which is not only deforming, but which it is almost impossible to remove (argyrosis). The usual method of application is to paint the well-everted lids with the solution by means of a camel's-hair pencil; but a much neater way, which avoids all possible contagion in case the brush should have been used on another patient, and which will allow us to regulate the amount of the remedy, is to employ a small pledget of absorbent cotton twisted around a hard-rubber probe or a small stick of wood, such as a match, for instance. As the pain

produced by this remedy is, as a rule, quite sharp, a little cocaine solution may be previously applied. In case there is an abundant discharge, which is apt to coagulate as it comes in contact with the nitrate of silver and produces a very rough and unpleasant feeling in the eye, it is well to cleanse the entire conjunctival sac with a mild solution of table salt, about half a tea-spoonful to a cup of water, removing in this way all the coagula and strings of mucus from the eye. A weaker solution, containing from ½ to 1 grain of nitrate of silver to 1 ounce of distilled water, may be entrusted to the patient, of which 1 or 2 drops are to be instilled into the eye daily.

Acetate of lead, or *sugar of lead*, was formerly used a good deal with and without the addition of opium. As the remedy may cause, however, dense opacities of the cornea when ulcerations are present, and which it is not always easy to ascertain, it cannot be too strongly condemned, especially as we have an abundance of more harmless drugs which can be used in its stead.

Ammonia was employed both in the shape of the chloride and the acetate. Its use is more or less painful, and it offers no special advantages:

℞. Liq. ammoniæ acetatis,
Aquæ rosæ, āā. f℥j.—M.
Sig. Two drops in eye three times a day in chronic catarrhal conjunctivitis.

Iodine has been employed in the form of a watery solution of the iodide of potassium:

℞. Potass. iodidi, gr. x;
Aquæ destillatæ, f℥j.—M.
Sig. One drop in eye morning and evening.

It has been used to clear diffuse opacities of the cornea.

Sulphate of copper was formerly, and is even now frequently, employed in collyria. A favorite compound was the aluminated sulphate of copper, or *lapis divinus*, which was made by fusing equal parts of sulphate of copper, nitrate of potassium, and alum, and adding $\frac{1}{20}$ part of camphor. The use of all the preparations of copper is painful and disagreeable, and should be preceded by applying a little cocaine to the eye:

℞. Cupri sulphat., gr. j;
Aquæ lauro-cerasi, f℥ss;
Aquæ destillatæ, f℥j.—M.
Sig. Use one or two drops in eye daily.

Or,

℞. Cupri aluminati, gr. v ;
Aquæ destillatæ, f℥ij ;
Vini opii, f℥j.—M.
Sig. One drop in eye three times a day.

To be used in cases of chronic granular lids.

Anodyne collyria are very little used at present, as cocaine has taken their place. An infusion of poppy-heads, a mild watery solution of opium, the diluted wine of opium, the fluid extract of witch-hazel, and cherry-laurel water can be employed as anodynes. Atropine solution is a powerful anodyne in all diseases of the cornea and iris, but, as a rule, a weak solution of cocaine will prove the most efficient remedy that can be employed, its use being at the same time more harmless than that of the other remedies :

℞. Cocain. hydrochlorat., gr. x ;
Aquæ destillatæ, f℥j.—M.
Sig. Use one drop in eye every half hour for pain.

Dry applications are made to the eye for various purposes. For phlyctenular diseases of the conjunctiva or cornea dry calomel is dusted into the eye, either in its pure state or mixed with equal parts of sugar : this was formerly well known as the dry collyrium of calomel. Applications of this kind are made by taking up a little of the powder by means of a small brush or a piece of absorbent cotton twisted around a probe and allowing it to drop into the eye by gently tapping the brush or probe with the finger. Calomel should not be used oftener than once a day, and care should be taken to guard against the internal administration of all preparations containing iodine, as this would reach eventually the tear-fluid and secretions of the conjunctiva, and change the calomel powder rapidly into the biniodide of mercury—a preparation which is very irritating and painful to the eye. Nor should the powder be applied in the evening, for if it should remain in large quantities in the eye during the entire night it would be changed into the bichloride of mercury by the tear-fluid, which contains more or less chloride of sodium. The bichloride would act as a caustic, and might cause deep burns of the eye, especially in the lower cul-de-sac of the conjunctiva.

Alum and borax are rarely used in the shape of powder, not even in a diluted state ; but alum and sulphate of copper are frequently employed in the crystalline form. Cones of this kind are prepared either by smoothing the crystals with a sharp knife or by rubbing them with a little water against a sandstone—the ordinary grind-

stone, for instance—until they have assumed a conical shape and are very smooth. This is absolutely necessary, for a sharp corner of the crystal might wound the conjunctiva and make the application very painful and irritating. The aluminated sulphate of copper may be used in the same form, and is known as the lapis-divinus cone. Even nitrate of silver may be used in a similar way, but, as it is very caustic in its effects, it is, as a rule, fused with 2, 3, or 5 parts of nitrate of potassium, and is known as the mitigated nitrate-of-silver cone, or lapis infernalis. The pure nitrate-of-silver stick may be used to destroy very large proliferations of the conjunctiva which have too broad a base to remove by means of the scissors, or to check hæmorrhage from very vascular granulations. The mitigated stick acts very well in localized granulations or in very profuse granulations and hypertrophies of the papillary layer of the conjunctiva, especially if this condition is accompanied by a profuse discharge of pus or mucopus. It is well to neutralize the excess of the remedy by washing the cauterized portion of the lid, especially the folds of transmission, with a solution of common salt: the parts should also be cocainized before the application is made, as it is liable to cause severe and lasting pain. The sulphate-of-copper cone is used very extensively for granular lids, and the aluminated copper—which is really a mitigated preparation of sulphate of copper—may be used for the same disease, especially in cases of old trachoma with marked cicatrization of the conjunctiva. The alum stick is frequently applied for the milder forms of chronic conjunctivitis. Its use is less painful than that of the former applications, and it may even be entrusted to the patient.

Eye spirits, or stimulating, aromatic applications, are made by dissolving essential oils in refined alcohol. Camphor and other remedies are sometimes added. Their use is stimulating and of a mild counter-irritant character. They are employed in asthenopic difficulties, and they are likewise very useful after severe inflammations; but they should never be employed as long as there is any active inflammatory condition of the conjunctiva or the cornea. They should be applied externally to the lids and surrounding parts of the eye, but care should be taken not to let any get into the eye. Only fresh and the best qualities of essential oils are suitable for these preparations:

℞. Spts. lavendulæ,
Spts. vini gallici, āā. f℥ss;
Spts. camphoræ, f℥j;
Spts. rosmarini, f℥iv.—M.
Sig. Apply to eyelids frequently during the day.

℞. Olei rosmarini, gtt. v;
Olei valeriani, gtt. iij;
Camphoræ, gr. v;
Alcoholis, fʒiij.—M.
Sig. Eye spirits.

℞. Spts. melissæ, fʒviij;
Spts. lavendulæ, fʒiss;
Spts. camphoræ, fʒiss;
Spts. aetheris nitrosi, fʒj.—M.
Sig. Eye-spirits.

℞. Olei lavendulæ, gtt. x;
Olei rosmarini, gtt. xxx;
Alcoholis, fʒvj.—M.
Sig. Apply externally to eyes.

Triturations for ophthalmic purposes are prepared by triturating the drugs with a small quantity of sugar of milk until they are very finely powdered, and mixing this again with a sufficient quantity of finely-pulverized acacia. Triturations have the advantages that they will keep for any length of time in a dry place in a pill-box or in a glass-stoppered bottle, that the dose of the remedy can be more carefully regulated, and that, on account of the admixture of the pulverized acacia it will stick to the conjunctiva until the preparation is entirely dissolved, even if there is profuse lachrymation, which would diminish the action of the drugs applied in solutions by washing them out of the eye before they had time to act on the conjunctiva or cornea.

On account of the great stability of the triturations, this form recommends itself especially for the purpose of keeping the rarer and less frequently employed drugs—such as duboisine and hyoscine. However, all the other medicines used in ophthalmic practice may be kept and applied in this form. Triturations containing 1 per cent. of the active principle are sufficient for all purposes: they can especially be recommended for the use of mydriatic and myotic remedies.

Gelatin disks, saturated with remedies usually employed in ophthalmic practice, are likewise a very convenient form of application. They are made by dissolving the drugs in a little water and mixing the solution with gelatin. These disks contain usually each $\frac{1}{100}$ to $\frac{1}{1000}$ part of an alkaloid, and are placed in the conjunctival sac of the patient, where they dissolve readily. They must be kept in a dry place or they will liquefy.

Eye-ointments or *eye-salves* are frequently employed for the purpose of preventing the lids from sticking together by keeping their free

margin well greased or lubricated, or for conveying certain remedies to the lids or to the conjunctival sac in conjunctival or corneal diseases. The vehicles formerly employed were lard, mutton suet, simple cerate, cold cream, or the glycerite of starch. The former, however, were liable to become rancid and irritate the eye, and the latter to become fluid. Their use is, however, now almost entirely superseded by vaseline (petrolatum). There are two varieties—the ordinary vaseline, which is of a very light-yellow color, and the white or bleached vaseline, sometimes called albolene. The ordinary vaseline is, as a rule, a very pure and bland article, which will keep unaltered for any length of time, and which will serve as a vehicle not only for the ordinary drugs usually employed in the form of ointments, but even the most delicate alkaloids will remain unchanged if mixed with vaseline much better than if kept in watery solutions. The drugs to be used should be either dissolved or triturated to an impalpable powder before mixing them with vaseline. If the salves are intended to lubricate or medicate the free edge of the lid, they should be applied by means of the finger, rubbing the preparation gently into the lashes of the partly-closed eyelids ; if they are intended for the conjunctival sac, they should be applied by means of a probe or smooth stick. The lower lid is to be everted or drawn down gently ; the salve is then placed in the lower cul-de-sac of the conjunctiva, and after the lid is allowed to close the probe or stick is withdrawn and the salve is left in the eye. A little gentle rubbing will now spread it over the entire eyeball and inner surfaces of the lid. Some remedies can be employed in this form in much stronger proportions than if used in watery solutions.

Salves may also be employed to convey irritating remedies to the neighboring parts of the eye for the purpose of causing counter-irritation or for a diseased condition of the lids. Great care should in these cases be exercised against letting any of the ointment get into the eye or touching the conjunctiva with the finger, as this would be very painful and might lead to serious consequences, and affect even the sight of the patient to a dangerous degree.

Another class of salves are applied to the surrounding parts of the eye for the purpose of affecting that organ through the general circulatory system. However, this mode of application is less frequently resorted to now than formerly ; and deservedly so, as we may affect the eye, as well as the general system, by means of hypodermic injections much more effectually.

Vehicles similar to fat for ophthalmic applications are sweet oil and castor oil. The thick, sticky condition of the latter makes it a very desirable preparation in those cases where the opposing conjunctiva of both the lids and the eyeball is in highly inflammatory con-

dition, or when these parts lying in apposition have been denuded of their epithelial lining, and especially if the parts have been burnt by alkalies or by strong mineral acids or by chrysophanic or carbolic acid. It is necessary that in such cases the applications should be made very frequently during the day and night. It is very convenient to dissolve in the oil at the same time such chemicals as may have a beneficial effect on the eye:

℞. Atropinæ, gr. j;
Olei ricini, fʒj.—M.
Sig. Apply one or two drops to eye every hour.

In order to preserve the sticky nature of the oil, the sulphate of atropine, which would have to be dissolved in water, and which if mixed with the oil would make an emulsion of it, cannot be employed. It is better to dissolve the pure alkaloid in a few drops of alcohol, which, after being mixed with the oil, can be easily removed by heating the solution gently: in this way a perfectly clear oily solution is obtained. Sweet oil may be dropped into the eye very freely after burns by lime or any other alkali, as it neutralizes the alkali and acts beneficially on the cornea and conjunctiva at the same time.

Ointments to be applied to the edge of the lid to prevent their gluing together in the morning are especially useful in all catarrhal affections, and even in the severer forms of conjunctivitis, and in granular lids. The blandest and simplest preparations are to be preferred for this purpose. The simple cerate of the Pharmacopœia or vaseline will answer very well for this purpose, or a mild boric-acid ointment may be used:

℞. Acidi borici, gr. xv;
Petrolati, ʒiij.—M.
Ft. ungt.
Sig. Apply to edge of lids at bed-time.

If the salve is intended for an inflammation of the lids, such as blepharitis ciliaris or eczema, the parts to be anointed should be carefully cleaned and dried, so that the salve will not only come in contact with the diseased parts, but will likewise adhere to them. The most important remedies used for this purpose are the different preparations of mercury and the oxide of zinc. For simple blepharitis use—

℞. Hydrarg. oxid. rubri, gr. x;
Unguenti, ʒss.—M.
Ft. ungt.
Sig. Apply to edge of lid at bed-time.

The salve should be removed the next morning by washing the lids with castile, or better with tar, soap. During the day the greasy condition of the lids is rather objectionable, and one application a day—just before retiring, for instance—will be sufficient:

℞. Hydrarg. ammoniati, gr. xx;
Pulv. camphoræ, gr. x;
Unguenti, ʒss.—M.
Ft. ungt.
Sig. Apply at night.

Or,

℞. Zinci oxidum, gr. xx;
Adipis benzoinat., ʒiij.—M.
Ft. ungt.
Sig. Apply at bed-time.

℞. Liq. plumbi. subacet., gtt. x;
Ungt. aquæ rosæ, ʒiij.—M.
Ft. ungt.
Sig. To be used for the more chronic forms of blepharitis marginalis.

℞. Hydrarg. oxidi rubri, gr. x;
Morphinæ sulph., gr. iij;
Unguenti, ʒiij.—M.
Ft. ungt.
Sig. To be applied twice a day for eczema.

These salves have been selected as being the simplest and most efficient for their purpose. In applications to the integument of the lids it is better to use a vehicle of more consistency than vaseline, which is liable to run down the cheeks and make the surrounding parts greasy.

For ointments to be applied to the conjunctival sac vaseline should be used exclusively. For phlyctenular conjunctivitis and keratitis, and also for maculæ of the cornea, use the following preparation:

℞. Hydrarg. oxidi flavi, gr. j;
Petrolati, ʒiss.—M.
Ft. ungt.
Sig. Apply to eye once a day.

This salve may be increased in strength, but, as a rule, it will be better borne if very weak:

℞. Acidi borici, gr. xxx;
Petrolati, ʒss.—M.
Ft. ungt.
Sig. Apply to eye every two or three hours.

* In very severe cases of conjunctivitis this salve may be used every half hour night and day:

℞. Hydrarg. oxidi flavi, gr. v;
Ungt. amyli glycer., ʒss.—M.
Ft. ungt.
Sig. Apply to eye every morning for ulcers of cornea.

For ointments to be used in the conjunctival sac and for the cornea it is always preferable to use the yellow oxide of mercury, made by precipitation. For affections of the lids the red oxide is preferable, but care must be taken to triturate the crystals very carefully, lest they irritate.

Ointments containing the extract of belladonna, sometimes mixed with mercurial salve, were formerly applied to the brows and temples in very severe cases of iritis, especially the syphilitic variety. However, at present atropine instillations and oleate of mercury externally are usually resorted to:

℞. Ext. bellad. aq., gr. xv;
Ext. opii aq., gr. v;
Unguenti, ʒij.—M.
Ft. ungt.
Sig. Apply to brow of affected eye two or three times a day.

℞. Ungt. hydrarg. ciner.,
Ungt. belladonnæ, āā. ʒij.
Sig. Apply a little to temporal region of affected eye three times a day.

℞. Oleati hydrarg., 20 per cent., ʒij.
Sig. Apply to temporal region by means of a brush three times a day.

Counter-irritants.—Remedies of this class were at one time much in vogue, and are even now quite popular with some physicians. They were applied to the temporal region and behind the ear. Blisters, especially the perpetual variety, or the cantharidal collodion, are much used, usually behind the ear.

Ointments to act as counter-irritants usually contain such remedies as veratrine or aconitine:

℞. Veratrini, gr. x;
Unguenti, ʒiij.—M.
Ft. ungt.
Sig. Apply to temporal region for neuralgic pains three times a day.

℞. Aconitinæ, gr. x;
Unguenti, ʒij.—M.
Ft. ungt.
Sig. Apply externally.

℞. Menthol., ʒj;
Unguenti, ʒiij.—M.
Ft. ungt.
Sig. To be used for headache.

℞. Acid. chrysophanici, gr. x;
Unguenti, ʒij.
Sig. Apply to lids for psoriasis; use with great care.

These remedies are very useful in intense neuralgic troubles, but great care should be taken not to let them get into the eye, as they not only cause intense pain when brought in contact with the conjunctiva, but they are liable to set up a very severe form of conjunctivitis and keratitis. In case of such an accident oil should be dropped into the eye freely.

Menthol has been used extensively in temporal headaches and supra-orbital pains. It is usually employed in the shape of pencils or cones, made by mixing the menthol with paraffin or wax. The oil of peppermint may be used in its place, either pure or dissolved in alcohol. The oil of mustard-seed has been employed very extensively and in a similar manner; it is, however, much more powerful than the former, and should therefore be used only in a diluted state. Mustard plasters are not to be recommended in this region, but vapors of chloroform act very nicely at times. A wide-mouthed bottle is half filled with cotton, and a little chloroform is poured on this. The mouth of the bottle is now held tightly over the seat of the pain, and kept here for some time until the pain is relieved.

Antisepsis in ophthalmology is of the utmost importance in regard to operative interference, but it must not be forgotten that the eye is constantly bathed or washed by an aseptic tear-fluid, which will render a great many of the less-powerful bacilli harmless. The greatest danger lies in the entrance of microbes into the interior of the eyeball, and the minutest care should therefore be exercised to have all the instruments which are introduced into the eye itself scrupulously clean, to disinfect

them very carefully, and, if possible, destroy all germs which may cling to them, by keeping such instruments in an antiseptic fluid, or after cleaning them thoroughly in aseptic solutions heat them in the flame of an alcohol lamp shortly before using them as far as this is possible without destroying their cutting power.

If carbolic acid is used for the disinfection of eye instruments, it should not be stronger than a 5 per cent. solution, and even this would affect the cutting edge of the knife, and should therefore be employed exclusively for non-cutting instruments, such as specula, fixation forceps, strabismus hooks, etc. These instruments should be kept in the carbolic-acid solution for ten minutes at least, and then cleaned and dried and immersed in absolute alcohol just before they are used. They can likewise be disinfected by the dry heat of an alcohol flame or by immersing them in boiling water for a little while. Knives and scissors may be prepared for an operation by cleansing them thoroughly in a boric-acid solution and keeping them in absolute alcohol up to the time they are to be used: they should be entirely free of all stains, especially rust stains, and they should be perfectly sharp, so as to avoid all tearing and bruising of the tissues they are to be used upon, as a clean-cut wound heals more rapidly, and is therefore less liable to become infected, than an irregular and partly bruised one.

An antiseptic spray is seldom used in ophthalmic surgery, but it is necessary to clean and disinfect the surrounding parts, the lids, eyelashes, and even the brows, of the patient, as germs might find their way into the eye from these parts during the manipulations accompanying the operation. For this purpose a weak solution of corrosive sublimate or one of boric acid or diluted alcohol may be used.

Water made aseptic by boiling will in most cases be sufficient to keep the instruments in during the operation, and it may likewise be used for cleansing the eye.

On account of the irritating properties of many of our most powerful antiseptics their direct use to the eye is limited. Into the interior of the eye, especially the anterior chamber, only Panas' solution of the biniodide of mercury (1 : 20,000) or the aseptic solution of boric acid can be employed with safety. As a rule, an antiseptic is rarely required for the anterior chamber, as the entrance of microbes, if the usual precautions are not neglected during the performance of an operation, is something very unusual, and an aseptic fluid is all that is necessary to remove blood or portions of the iris and lens from this chamber. The conjunctival sac is also quite sensitive, especially when in an irritated or inflamed condition, so that only few remedies with antiseptic properties can be used. Even in severer injuries, when the eyeball itself has been wounded extensively or when the entrance of an infectious foreign body makes it necessary to use the most powerful

disinfectants, these may have to be used, principally on account of their irritating action, in such a diluted condition that they become more aseptic solutions than actual disinfectants, and therefore of not much more practical value than the aseptic boric-acid solution. The bichloride-of-mercury solution, for instance, will have to be made very weak (1 : 10,000) in order not to be irritating, although in suspicious cases—for instance, where there is danger of infection from an old blennorrhœic inflammation of the tear-sac—a stronger solution (1 : 5000 or even 1 : 3000) may have to be used ; but the latter cannot be employed as freely or as long as the weaker ones without giving rise to great irritation, and even inflammation, of the conjunctiva.

Much stronger corrosive-sublimate solutions, or even more irritating antiseptics, such as carbolic acid or nitrate of silver, may be used locally—for instance, to ulcerations of the cornea ; but for general use much milder and less irritating substances are preferable. Boric acid, although not exactly an antiseptic, is more frequently employed than any other remedy, usually in the form of a saturated solution, which is in the proportion of 1 : 25, or 20 grains to 1 ounce of water. A more concentrated preparation is the ointment of boric acid, in which 1 part to 8 parts of vaseline may be used. This mode of application has great advantages in cases of infectious inflammations where it is desirable not only to have the remedy in a concentrated form, but to have it remain in contact with the inflamed parts as long as possible. In such cases the salve may be applied as often as every half hour or every hour. It has the additional advantage that it prevents the lids from sticking together, which would mean retention of the secretion, combined with the danger of more infection and great irritation by the pent-up discharge, which, acting as a foreign body, will cause more pain and pressure, and consequently greater danger to the cornea. The retained secretion will sometimes become a source of great danger to the attending physician or nurse. At the time such an eye is forcibly opened the secretion is liable to squirt out with considerable force, and may even be thrown into the eyes of the attendants. It is therefore advisable for the nurses having charge of such patients to wear large coquille spectacles for protection, although this danger of contagion is of course not so great when the boric-acid ointment is used on the patient's eyes.

Most of the collyria employed in ophthalmic practice have antiseptic properties, but they are not classed among the antiseptics proper. For instance, nitrate of silver, alum, and sulphate of copper are powerful disinfectants, but they are rarely used as such. As before mentioned, the bichloride and the biniodide of mercury are the most powerful and valuable antiseptics, and are used extensively in spite of their somewhat irritating qualities. The strength of these

solutions varies according to the object in view. In order to disinfect sloughs and ulcerations of the cornea the bichloride may be used in the strength of 1 : 3000. For unclean wounds with a slight amount of marginal infiltration 1 part of bichloride to 5000 parts of water is needed. However, in inflammations of the conjunctiva, even those due to the action of the gonococcus, and in all similar cases where an abundant discharge and threatened invasion of the corneal tissue demands prompt and energetic cleansing and disinfecting of the conjunctival sac, it is not safe to make the solution of the corrosive sublimate stronger than 1 to 8000, or possibly 1 : 10,000, parts of water. The biniodide of mercury is only employed in making Panas' fluid for injection into the anterior chamber of the eye, in the proportion of 1 : 20,000.

Pyoktanin is one of the aniline dyes: it is used in varying strength of 5 to 20 per cent. solutions, and is employed especially for the disinfection of corneal ulcers. Its use is, however, limited.

Chlorine gas dissolved in water is known as the aqua chlori: it is, if fresh, a powerful and yet only slightly irritating antiseptic, and has been used for this purpose in purulent diseases of the conjunctiva and cornea quite extensively and for many years, since A. Von Graefe recommended it for this purpose. It is to be diluted with 2 or 3 parts of distilled water just before it is used, and should be kept in a cool and dark place. It may be employed quite freely by means of a little syringe—of course the more freely the weaker the solution. The greatest difficulty is to obtain it perfectly fresh: it is decomposed so rapidly that the preparation kept by the druggists, no matter how carefully it is preserved, is, as a rule, perfectly useless on this account; and not every druggist has the apparatus necessary to make it at short notice. It is therefore advisable to use in its place the chlorinated soda, known as Labarraque's solution, which is to be diluted with 5 parts of water.

The peroxide of hydrogen is a similar preparation: its efficacy depends entirely upon its freshness. Only recently recommended as an antiseptic and disinfectant preparation, it has gained rapidly the reputation of being perhaps the most reliable drug of its kind. It is usually kept in a 20 per cent. solution, and may be diluted with several parts of water for application to the conjunctiva. A preparation made by Marchand is, as a rule, a stable and reliable germicide.

Resorcin has been very little used in ophthalmic practice: it may be employed in solutions containing from 2 to 5 per cent. or it may be mixed with vaseline.

Permanganate of potassium is known as a powerful germicide: however, it is decomposed so rapidly by contact with organic substances that it is more of a disinfectant. For the eye it should not be

employed stronger than in ½ per cent. solutions, which, however, may be used quite freely, especially if there is an abundance of secretion.

Iodoform is used in certain diseases of the eye, such as diphtheritic and phlyctenular conjunctivitis, and also in wounds and ulcers of the cornea. The preparation should always be very finely pulverized if applied to the eye. Its germicidal power is, however, doubtful, and its use is very limited. For localized foci of infectious matter, such as ulcerations, especially those of the cornea, or in impure and infiltrated margins of corneal wounds, the use of the actual or the electro-cautery cannot be too highly recommended.

Leeches in ophthalmic surgery are serviceable in acute inflammations of the iris, the ciliary body, and the cornea, especially in rapidly-developing ulceration of the latter. In iritis, as well as in cyclitis, they are indicated if the severe pain accompanying these diseases cannot be relieved by the free use of atropine, and especially if the eye remains extremely sensitive to the touch after the atropine has been applied. The leeches, of which, as a rule, two or three are sufficient at a time, should never be placed to the lids nor very close to them, as their bites in this locality are liable to be followed by diffuse infiltration of the parts, and may even give rise to erysipelas; but the principal reason for not placing them there is the fact that they would be of little service in checking the inflammation. They should be placed on the temporal region, a little above the tragus of the ear. They should never be forcibly detached, as their teeth are then liable to remain in the wound and cause suppuration or marked irritation: they should be allowed to drop off of their own accord, and by the application of hot wet towels the continuation of the flow of blood should be encouraged. In order to check the bleeding at any time, it suffices generally to press the finger on the leech-bite for a few minutes or to apply a little creasote or styptic cotton to it: if all these means fail, use a fine point of nitrate of silver. The artificial leech, or heurteloup, consists of a cutting instrument and a cylinder for suction and the reception of the blood. In this manner the blood can be drawn very rapidly, and, as the peripheral vessels are more or less compressed by the cylinder, the blood is drawn from the deeper parts; the instrument is therefore supposed to be of special service in deep-seated inflammations—in choroiditis, for instance. It should be applied to the lower temporal region between the outer canthus and the tragus.

In using leeches in the neighborhood of the ear precautions should always be taken not to allow them to crawl into the ear and perhaps injure the drumhead; this can be easily prevented by putting some cotton into the ear before they are applied.

Scarification may have to be resorted to in severe cases of conjunctivitis when there is an intensely engorged condition of the con-

junctival vessel which threatens to interfere with the nutrition of the cornea on account of its pressure upon this organ. Slight and superficial incisions are made to the everted conjunctiva, usually of the lid, by means of a lancet or sharp scalpel. Bleeding may be encouraged by means of the application of warm water.

Cups are usually employed in the form of dry cups to the temporal region or to the back of the neck. In place of the glasses usually employed for this purpose, a soft-rubber cup, which is applied simply by compressing it and placing it against the temples, is highly recommended.

Sprays and Douches.—The use of an atomizer for the production of a spray is of recent date in ophthalmic practice. Sprays are especially indicated in mild forms of conjunctivitis and blepharitis. The solutions used in the atomizer must be very mild and bland. The borate and the bicarbonate of sodium are employed in the strength of 1 to 2 grains of the drug to 1 ounce of water. A spray of the fluid extract of hamamelis, or witch-hazel, is useful for the hot and itchy sensation brought on by long-continued use of the eyes, especially in an overheated or smoky atmosphere, and a spray of weak cocaine solution acts like a charm in allaying the intolerable itching and intense photophobia of hay fever :

℞. Cocainæ hydrochlor., gr. v ;
Aquæ destillatæ, ℥ij.
Sig. Use in atomizer three or four times daily, or as occasion demands.

Douches are intended to exert a tonic and stimulating effect upon the eye, and are of great service in relieving some of the asthenopic symptoms which follow the continued use of the eye if the state of the patient's health is feeble or if the eyes are overtaxed by using them much in artificial light, especially if the work is done so close to the light that the heat of the flame affects the eye. If the use of proper glasses, when they are needed, does not relieve the asthenopia entirely, the douche will sometimes act very beneficially. It consists in the forcible application of a stream of water, or better of several small streams, to the closed eyelids. A perforated end-piece is attached to a vessel containing cold or hot water by means of a rubber tube ; the vessel is then raised to a sufficient height to cause the stream of water flowing through the perforations of the end-piece to strike the eye with some force : where there is flowing water the tube may be connected with the faucet and the force of the flow of the water may be regulated by pressure exerted upon the rubber tubing by means of the fingers. In asthenopic troubles the cold stream is more agreeable, but for keratitis or iritis the hot douche is

needed. The temperature of the water, if used in this way, may be very high, and in these diseases, if they are accompanied by much and intense pain, the water may have a temperature of 150° F. In using the douche the patient's clothing should be protected by means of towels fastened around his neck. A vapor douche may be prepared by pouring a steaming hot, aromatic infusion—of the German chamomile, for instance—into a basin. While the patient holds his head over the basin a cloth is thrown over both head and basin. The eyes may thus be brought in contact with the steam of the infusion, containing some of the essential oil of the plant, for five or ten minutes at a time.

Massage has been recently employed in ophthalmology for the purpose of assisting in the clearing up of corneal opacities, for the cure of incipient cataract, for the maturing of immature cataracts, and for the relief of asthenopia and some chronic diseases of the eye. In order to practise massage properly the hand of the operator should rest against the temples of the patient, and the thumb should be used to perform a gentle but steady rotatory movement over the closed lids, or the operator may stand behind the patient and rub the eye with his first three fingers gently from nose to outer canthus. If massage is employed for the clearing up of corneal opacities, a mild ointment of the yellow oxide of mercury may be put into the eye, and for the clearing up of lenticular opacities a solution of boric acid and glycerin should be used at the same time. In order to hasten the ripening of an immature cataract the cornea should be gently stroked with the curved back of a strabismus hook, after an iridectomy had been made and when there is no aqueous humor in the anterior chamber, for about five minutes. One application of this kind suffices, as a rule, to obtain the desired result. Massage is of great service in some slow forms of phlyctenular disease, and especially in the central variety of episcleritis. In these cases it should be resorted to once every day, and continued for about five minutes each time.

Electricity in ophthalmology has become a very important help: not only does it enable us to operate at any time of the day or night by means of its light, but it also allows us to test the vision and the color-perception in the evening. The question whether it is hurtful to the eye depends upon the kind of light used. The carbon lights are too intense and unsteady to be used for reading or writing, but the gentle and quiet light of the incandescent arc can do only good by furnishing a purer and better illumination than either gas or oil; and the absence of heat is a great convenience and lessens the tendency to conjunctival congestion and redness of the edges of the lid. In all deep-seated diseases, especially those of the retina and choroid, the brightness of the light is very objectionable, and should be

guarded against as carefully as is sunlight by the use of shades and colored glasses. Electrolysis has been used for nævi of the lids and for tumors of various kinds, and also for the destruction of eyelashes which could not have been effectually operated upon by any other plan. Electro-cautery has become a universally acknowledged and adopted method of treating ulcers of the cornea or infected margins of wounds of the eye. Its use is somewhat painful, but a few drops of cocaine solution previously applied will prevent the pain. Its light and the hissing sounds accompanying the operation make its use objectionable in nervous persons, so that even a general anæsthetic may have to be administered. Great care should be taken not to perforate the cornea when using it for deep corneal ulcers, but even this accident is not very serious, and does not delay the healing of the ulcer very much. The resulting scar is, as a rule, not denser than that of the ulcer would have been. Electro-cautery may be used for ulcerations of other parts of the eye or of the lids, and is of great service in treating ulcus radius or lupus and epithelioma, warts, etc. The *galvanic* and the *faradic current* are both frequently used in ophthalmic practice, the former for atrophic changes of the optic nerve. The galvanic current is especially useful in amblyopia and diseases due to the abuse of tobacco or liquor, in very chronic forms of choroiditis with exudation, and in asthenopic troubles of the eye. It has been recommended to produce rapid absorption of remedies which are applied to the cornea for the purpose of clearing up dense opacities of this organ; and for this purpose the negative pole should be applied to the eye. It has also been supposed to aid in the clearing up of lenticular opacities. Electricity has undoubtedly a stimulating effect upon the circulation of the eye, and may on this account, by improving the nutrition of the organ, have some influence in clearing such opacities, which depend, as has recently been sufficiently demonstrated, upon defective nutrition due to imperfect endosmosis of the nutrient fluid. There can hardly be any doubt that it favors the process of osmosis materially. The faradic current is especially to be recommended for muscular affections, such as paralysis, and for asthenopic troubles. It acts very beneficially in asthenopic pains which are due to errors of refraction or to insufficiencies of the external muscles. The mode of application does not vary much for the two currents. In localized paralysis of one or more muscles of one eye the negative pole should be applied to the back of the head and the positive pole over the affected muscle, either through the closed lids, or, what is even better, to the muscle itself if possible. The eye must be cocainized for this purpose, and the lids should be kept apart, so as not to interfere with the application. In asthenopic troubles where both eyes are similarly affected, and in other diseases affecting both eyes, the electrodes may

be placed over the closed lids. The current used should never be so powerful as to cause pain, but it must be strong enough to be felt distinctly by the patient. It is necessary to have small electrodes, which are made for this purpose. The use of electricity by passing it through a cup filled with water which is held to the opened eye, forming a kind of electric bath, has been recommended, but the advantage of this method is doubtful.

DISEASES OF THE CONJUNCTIVA, SCLERA, AND CORNEA.

By GEORGE E. de SCHWEINITZ, M. D.

DISEASES OF THE CONJUNCTIVA.

Diseases of the conjunctiva affect about 63 per cent. of the patients who apply for treatment of the eyes in hospital service, and probably 30 per cent. of those who come in private practice. These figures emphasize the importance of the therapeutic measures employed in diseases of this membrane.

Hyperæmia of the Conjunctiva.

This is a disease characterized by overfilling and tortuosity of the posterior conjunctival vessels and absence of any considerable secretion of mucus or pus, and is unassociated with loss in the translucency of the affected membrane. The subjective symptoms are a feeling of heat in the eyes, weariness at close work, and discomfort in bright light. The condition depends upon the action of a local irritant, diseases of the naso-pharynx, various states of depraved general health, diseases of the liver, congestion of the portal area, and gout. In some cases it presents itself in the form of recurrent attacks of an acute type suggesting vaso-motor influence, while others are probably similar to the recurrent ophthalmias which were ascribed by the older writers to the influence of malaria. The causes of hyperæmia of the conjunctiva furnish the indications for treatment.

The patient should be removed from deleterious occupations, or, if this is not possible, the eyes should be protected with smoked glasses. The influence of eye-strain, either from defective muscular balance or from ametropia, is to be carefully eliminated before making local applications. Presbyopia, when its subject delays the use of the needed reading-glasses, produces hyperæmia of the conjunctiva. The posterior nares should be examined, and any congested condition of the turbinated bones or chronic catarrhal state of the upper respiratory passages should be removed. This is particularly true of the hyperæmia seen early in the

morning or upon rising, sometimes associated with slight frontal headache.[1]

A persistent hyperæmia may be associated with certain constitutional disorders, and one form, seen with gout, is analogous to the "hot eye" of Mr. Hutchinson—a condition which will not subside under local treatment, but which requires the ordinary anti-gout measures. Proper attention to the functions of the liver and the intestinal tract are important adjuvants in the treatment of this very simple but often troublesome affection.

Local measures are needed if there is any altered secretion, and a saturated solution of boric acid[2] or a weak solution of bichloride of mercury, 1 : 10,000, may be employed. The boric-acid solution is more stimulating if to each ounce is added 1 or 2 grains of sulphate of zinc, 4 grains of alum, or 3 or 4 grains of common table salt. Nitrate of silver, so commonly employed in hyperæmia, is not of service. If there is relaxation of the conjunctiva, tannin and glycerin, in the strength of 10 and 20 grains to the ounce, are useful applications. Before any local measures are employed care should be taken to notice if the puncta lachrymalia are patent, and whether any incurved cilia rub against the conjunctiva and aggravate the difficulty.

The most important group of diseases of the conjunctiva are those to which the general term *ophthalmia* is applicable, characterized, like hyperæmia, by injection of the posterior conjunctival-vessel system, but unlike it associated with a considerably altered secretion. The first of these are cases characterized chiefly by a secretion composed of mucus, muco-pus, or pus.

Muco-purulent Ophthalmia (Catarrhal Ophthalmia, or Conjunctivitis).

This disease, recognized by congestion, some dread of light, spasm of the lids, loss in the translucency of the affected membrane, and a muco-purulent discharge, varies exceedingly in the severity of its symptoms, and may manifest itself in a mild type analogous to hyperæmia, or as an intense muco-purulent inflammation differing only in degree from the most violent purulent inflammations presently to be described. Although these various types of muco-purulent ophthalmias have diverse origins—for instance, as the accompaniment of the exanthemata (exanthematous ophthalmia); as the result of the presence

[1] "Reflex Ocular Symptoms in Nasal Affections," Gruening, *Medical Record*, Jan. 30, 1886.

[2] The value of boric acid, so much employed in ophthalmic practice, was first brought prominently to the notice of the American profession by Dr. Samuel Theobald (*Medical Record*, Feb. 7, 1880). The previous use of this drug in ophthalmology is described by the same author in an interesting letter (*ibid.*, Mar. 20, 1880, p. 328).

of micro-organisms and occurring in epidemics (epidemic conjunctival catarrh), one form of which is said to be due to a special bacterium, and to which the absurd name of "pink-eye" has been given; in association with rheumatism, catarrhal diseases of the naso-pharynx, bronchitis, eczema, impetigo contagiosa, etc. (associated ophthalmias); on account of local irritants, foreign bodies, and the like (traumatic ophthalmias); and finally symptomatic of a neglected ametropia (symptomatic ophthalmia),—the local treatment is practically the same for each variety.

The indications for preventive treatment are given by the etiology of the various types.

At the height of the attack the eye should be frequently and thoroughly cleansed with a weak solution of bichloride of mercury or one of boric acid. The edges of the lids should be frequently washed with soap and water. The lids may be everted and the surfaces brushed over with nitrate of silver, 2 to 5 grains to the ounce, if the discharge is copious. In the later stage, when the secretion is scanty, the nitrate of silver should be discontinued and some other astringent collyrium substituted. Zinc and alum answer very well. Ordinarily it is not necessary to use atropine unless a corneal ulcer complicates the disorder. *The eye should never be bandaged*, and meddlesome domestic medication in the form of poultices, scraped potatoes, tea-leaves,[1] and other similar applications in more than one instance has aggravated a simple catarrhal ophthalmia into a dangerous purulent inflammation. Good diet, fresh air, and exercise, iron if there is anæmia, quinine, especially for patients coming from damp, but probably malarious quarters, and cod-liver oil if scrofula is present, are indicated. Muco-purulent ophthalmia of any type becomes a grave disorder if it breaks out in schools, homes, or other institutions where numbers of children gather together. In the event of an epidemic under these circumstances scrupulous attention to the isolation of the affected inmates, strict cleanliness, and especially the use of separate utensils and towels, are necessary. The reader may refer with benefit to a paper by Sydney Stephenson entitled "The Ophthalmic Isolation School at Hanwell,"[2] and also to comments on this disease and allied conjunctival disorders as they occur in large institutions, in the *British Medical Journal* (1889, vol. i.).

Purulent Ophthalmia (Acute Blennorrhœa of the Conjunctiva).

It is customary to consider this affection in two forms—namely, ophthalmia neonatorum, or that type which occurs in the newly born,

[1] The use of tea-leaves may produce a form of conjunctivitis known as tea-leaf conjunctivitis.

[2] *Lancet*, April 5, 1890.

and gonorrhœal ophthalmia, or that variety seen in adults. The source of infection is similar in both types.

Ophthalmia Neonatorum.—This is an inflammation of the conjunctiva characterized in its usual form by great swelling of the lids, serous infiltration of the bulbar conjunctiva, and the free secretion of contagious pus. It is caused by the introduction into the eye of some infecting material from a portion of the genito-urinary tract of the mother at the time of or shortly after the birth of the affected infant. The gonococcus of Neisser is present in the majority of cases, although Cohn and other systematic writers have described two types—one supplied with the micro-organism, exhibiting the tendency to increase in severity and invade the cornea, and a milder, non-specific variety, with a tendency to recover. Hence a virulent vaginal discharge is not necessary to produce this condition except in its intense degree, and it probably arises from the contamination of any muco-purulent discharge during birth. Although Crédé maintains that a pure catarrhal secretion does not produce blennorrhœa, Hausmann,[1] on the other hand, believes that vaginal secretion may be contagious. Contact with the lochial discharge may originate a mild type of ophthalmia, but inoculation with healthy lochia in the hands of Zweifel[2] and Andrews[3] has failed to develop blennorrhœa. After birth the child may become infected by the careless use of soiled towels, and, as especially urged by Andrews, care during the post-puerperium is most necessary, requiring on the part of the accoucheur and nurse sedulous application of the proper means to prevent contamination.

The management of ophthalmia neonatorum naturally divides itself into *prophylaxis*, and the *treatment* of the various stages of the disorder.

Prophylaxis.—The statistics of Professor Magnus of Breslau, carefully compiled for Europe, and Germany in particular, have demonstrated that 71.99 per cent. of all who become blind during the first year of life are rendered sightless by purulent ophthalmia; in other words, he has shown that of every 10,000 children under five years of age, 428 are blinded by this type of conjunctivitis. The proportion of blind from this cause in the asylums of Switzerland is 26 per cent.; in Spain and Belgium, about 12 per cent.; and in the United Kingdom, 30 per cent. of the inmates of institutions, and 7000 persons have lost their sight from the same disease. These facts are recorded in the report of the Royal Commission of the Blind.[4] Rivière[5] of Bordeaux declares that purulent ophthalmia alone is

[1] *Archiv f. Gynaekol.*, 1881, Bd. xxi. p. 523.
[2] *Ibid.*, Bd xxii. p. 327; also *ibid.*, Bd xxiii. p. 325.
[3] *New York Medical Journal*, Oct. 25, 1885.
[4] *Lancet*, July 20, 1889.
[5] *Annales de Gynécologie*, June, July, August, 1887.

responsible for nearly one-third of the cases of blindness, and has placed in the care of Europe wellnigh 100,000 victims. More than 32 per cent. of the blind in our own country owe their affliction to ophthalmia neonatorum, and Howe[1] of Buffalo, in a collection of 8574 cases of labor conducted without preventive methods, found 8.66 per cent. of blennorrhœas. In the face of these facts the measures to prevent ophthalmia neonatorum rank in importance with those employed against small-pox and tuberculosis, and demand the assiduous practice of the means which experience has taught to be effective. The day ought not be far distant when stringent legislative regulations will be in force to militate against this appalling cause of blindness. Indeed, on several occasions this suggestion has been urged upon the government of England, and attention has been called to the enormous amount of blindness caused by purulent ophthalmia of new-born infants;[2] and N. Becker[3] in Russia recommends that the method of Crédé, as well as vaccination, shall be obligatory. In the absence of distinct governmental interference it is the plain duty of physicians, nurses, and directors of public charities to instil among the poorer classes a knowledge of the dangers of the disease and the necessity of prompt treatment. In this connection the following paragraph from the report of the committee of the American Ophthalmological Society on the "Causes and Prevention of Blindness" is important:[4] "It should be the endeavor of those familiar with the subject to appeal particularly to the examiners of midwives, and, when possible, to midwives themselves, in order to impress upon them the dangers of ophthalmia neonatorum, or, still better, to encourage the enactment of laws in various States which would require nurses promptly to report every such case to some legally-qualified practitioner. The fact that nurses and midwives in most States have a very irresponsible position which enables them to do much harm; the fact that a very little negligence or delay with this class of cases often results most disastrously to the patient; and the fact that the duty of nurses in this respect in foreign countries has already been established, and at least by one State in the Union,—inspires the hope that creditable reformation may take place in other parts of our own land."

According to Horner,[5] the first attempts at prophylaxis were made by Bischoff in Basel, who employed washing out the vagina before birth with injections of carbolic acid and the eyes of the newly-born with salicylic acid, and in 1876, Schies used instillations of carbolic

[1] *Trans. Med. Soc. State of New York*, 1889, p. 263.

[2] *British Medical Journal*, May 25, 1889.

[3] *Sitzunsb. d. mediz. Gesellsch. zu Woronesch.*, f. 1888–89, p. 22, abst. *Nagel's Jahresbericht.*, xx, Jahrgang, p. 84.

[4] *Trans. Amer. Oph. Soc.*, 1890.

[5] *Handbuch der Kinderkrankheiten*, Gerhardt, 1882.

acid and thymol. Other clinicians (Abegg, Olshausen, Briese, Fieuzal) in similar manner, sometimes using simply water, endeavored to thwart this evil. To Crédé[1] of Leipzic, however, belongs the credit of having secured, by the use of nitrate of silver, a rational preventive treatment. His method consists of the instillation of 2 drops of a 2 per cent. solution of nitrate of silver in the eyes of the newly-born child, which, as soon as it is expelled from the maternal passages and before the cord is cut, is placed upon its back in the bed, the eyelids parted, and the drug introduced. This, in some instances, is repeated on the second day; in the mean time small compresses soaked in a solution of salicylic acid are laid upon the closed lids. Crédé's first trials were made in 1879 with borax 1 : 60, but in June, 1880, he began with nitrate of silver. Previous to the nitrate-of-silver treatment, among 2266 births, 226, or 10.07 per cent., of ophthalmias occurred; after the introduction of the method from June, 1880, to March, 1883, among 1160 cases of labor the percentage of ophthalmias fell to 0.31. This gratifying result has been secured in a number of maternity clinics, and a comparison of the results before and after the introduction of the method may be seen from the accompanying table, quoted from Peuch,[2] who has compiled it in large measure from the memoir of Rivière:[3]

Observers.	Hospitals.	Before the introduction of the method.		Per cent.	After the introduction of the method.		Per cent.
		No. of births.	No. of Ophthalmias.		No. of births.	No. of Ophthalmias.	
Crédé	Leipzig . . .	2266	226	10.07	1160	?	0.1–0.2
Bayer	Stuttgart . .	?	?	22.33	361	0	0
Koenigstein .	Vienna . . .	1092	54	4.76	1300	?	1
Braun	Vienna . . .	?	?	4.34	500	2	0.4
Krukenberg .	Bonn	1266	?	7.3	703	?	0.56
Taufer	Pesth	?	?	?	130	1	0.76
Schatz	Rostock . . .	?	?	12.05	?	?	4
Schatz	Rostock . . .	?	?	?	1882	0	0
Brose	Berlin	?	?	?	460	7	1.5
Léopold . . .	Dresden . . .	?	?	?	1062	7	0.69
Léopold . . .	Dresden . . .	?	?	?	500	0	0
Albegg . . .	Dantzig . . .	?	?	?	?	?	3
Garrigues . .	New York . .	?	?	?	351	0	0
Rivière	Bordeaux . .	109	12	.11	189	0	0
Vinay	Lyon	?	?	?	400	0	0

In 1881, Olshausen[4] proposed to substitute for nitrate of silver a carbolic solution of the strength of 1 per cent. A year later De Wecker[5] recommended bathing the eyes of the newly born with a lotion of boric acid 4 : 100 or carbolic acid 2 : 100.

[1] *Archiv f. Gynaekol.*, xvii. 1, S. 50.
[2] *Archives de Tocologie*, vol. xvii. 1890, p. 84.
[3] *Loc. cit.*
[4] *Centralbl. f. Gynäkol.*, No. 2, 1881.
[5] *Gazette des Hôpitaux*, April 15, 1882.

In this connection the following statistics, quoted from Fuchs,[1] are interesting:

	No. of Children.	Oph. Neonatorum. Per cent.
No treatment	1092	19.26
1 per cent. carbolic acid	1541	7.42
Crédé's method	1250	5.44

In the Obstetrical Clinic at Berlin in 1883 nitrate of silver was replaced by solutions of corrosive sublimate, 1 : 1000, and the same practice was employed in the Maternity Hospital of Breslau. In 1886, Kaltenbach[2] advocated vaginal douches of bichloride of mercury (0.4 per cent.) and washing the eyes with distilled water, and with this procedure was able to conduct 200 labors without a single case of ophthalmia. L. Korn[3] concluded that painstaking cleanliness during birth and also in childbed may reduce the possibility of the disease to a minimum.

Peuch[4] records the methods to which he had recourse in the Obstetrical Clinic of Montpelier, and compares the method of Crédé with that advocated by Hegar-Kohrn, which is performed as follows: A convenient vessel contains small pledgets of antiseptic absorbent cotton moistened with Van Swieten's solution (corrosive sublimate 1 part, alcohol 100 parts, water 900 parts). This receptacle is placed within reach of the accoucheur, who supports the perineum with one hand, the other remaining free to take up the moistened pledgets. As soon as the head of the child is born the closed eyelids are carefully dried with two or three portions of the prepared cotton. When the child is entirely expelled it is placed upon its back, and before the cord is tied the eyelids and all the tissue surrounding them, especially the angles of the eye, the root of the nose, and the eyebrows, are carefully cleansed with the same solution until an absolutely aseptic surface is obtained. During this whole procedure care is taken that the child does not put its hands to its eyes before they have been cleansed in the bath which is prepared for them. Peuch concludes that the method of Crédé is still the chosen one, but the incontestable value of that of Hegar-Kohrn is proven. He would employ the former in maternity hospitals and in the course of grave epidemics of ophthalmia, and the latter in private practice. All things considered, it is evident that Crédé's method "is still the chosen one;" and even Kaltenbach and Korn, who have advocated other forms of prevention, admit without reserve that nitrate of silver, properly applied, meets with invariable success.

Sometimes the instillation of the silver solution causes hyperæmia and secretion of the conjunctiva, which disappears in a few days, and

[1] *Die Ursachen und der Verhütung der Blindheit*, Wiesbaden, 1885.
[2] *Archiv f. Gynaekol.*, xxviii. S. 406. [3] *Archiv f. Gynaekol.*, xxxi. 2, S. 240.
[4] *Loc. cit.*

two instances are known—one of which is recorded by Pomeroy[1] and another by the author[2]—in which alarming hæmorrhage from the conjunctiva has followed this treatment, and has been attributed to the action of the nitrate of silver. But the enormous value of this prophylaxis of ophthalmia neonatorum has demonstrated that Crédé's judgment of the strength of the silver solution was wise, and a few accidents after its use are nothing as compared with its preventive qualities—qualities which have saved hosts of children from the misery of blindness.

TREATMENT.—In order properly to appreciate when the various local applications are suitable, it is convenient to divide a typical case of ophthalmia neonatorum into four stages, and the classification of Mules[3] is convenient.

The first stage, or that of incubation, lasts about fifty hours, the fully-formed disease beginning on the third day after birth, sometimes as early as twelve to forty-eight hours after inoculation, or again, when it is the result of secondary infection from soiled fingers or sponges or cloths, at a much later date. During this time a slight redness of the conjunctiva with a trifling discharge in the corner of the eye and some feeling of heat and prickling are the only symptoms.

The second stage, or lymph-secreting period, is characterized by the appearance of a free secretion, somewhat sticky, with congestion of the palpebral conjunctiva associated with œdema and swelling of the lids.

The third stage rapidly succeeds the second, and consists of an aggravation of previous symptoms. There are great cushion-like swelling of the lids, intense chemosis, and congestion of the conjunctiva, accompanied by severe pain and discharge. The surface of the swollen lid is hot, dusky red, and tense; the upper lid overhangs the lower, and at first can only with difficulty be everted. The discharge has now assumed a yellow or greenish-yellow color and is secreted in great quantities. The conjunctiva is swollen, red, and velvety, and that upon the eyeball intensely injected. Flakes of lymph appear, the conjunctiva grows rougher, spots of dark-red color and ecchymosis are apparent; the whole tissue is succulent and easily bleeds. The chemosis of the ocular conjunctiva forms a hard ring around the margin of the cornea. At the bottom of the crater-like pit thus produced this membrane is seen. The thick cream-like discharge increases, flows out from beneath the overhanging upper lid, or is packed up in the conjunctival cul-de-sac.

The fourth stage, or the period of recession, is characterized by a gradual declining of the previous symptoms. The lids become less tense, the discharge diminishes, the conjunctiva is puckered into folds

[1] *Medical Record*, Aug. 20, 1887. [2] *Ibid.*, April 18, 1891.
[3] *Medical Chronicle*, vol. vii., 1887–88, p. 271.

and the papilla into elevations, and in from six to eight weeks the inflammation subsides, leaving the surface of the lids in a granular condition from the hypertrophy of the conjunctival papillæ.

The chief danger of the disease is the destruction of the vitality of the cornea, the formation of ulcers, and sloughing of the tissue. In bad cases there is perforation of the ulcer, evacuation of the anterior chamber, prolapse of the iris into the wound, and the formation of pyramidal cataract. In other cases large adherent cicatrices or leucomas result. In the worst examples there is such extensive sloughing of the corneal tissue and total prolapse of the iris that all the parts are matted together, producing a protruding cicatrix known as a total anterior staphyloma. Finally, perforation may be followed by inflammatory involvement of all of the tissues of the eye, rapid destruction of the globe on account of panophthalmitis, followed by shrinking and atrophy of the ball.

During the incubation stage, if attention is called to the case, the treatment is simply that of a mild conjunctivitis, and the slight secretion which gathers in the corners of the eye should be assiduously washed away with a tepid solution of boracic acid.

In the next stage—which, indeed, as far as the disease is concerned, is commonly a mixture of what has been described as the first and second stages, the lids being tense and the secretion lacking in its later creamy character—in addition to absolute cleanliness the local application of cold is the most efficient agent. Kries[1] has shown that the coccus develops only slowly at a temperature of 90° to 92° F. Weeks[2] finds that the temperature of the conjunctival sac in the various degrees of inflammation ranges from 98° to 102° F., and also finds that by constant cold applications the temperature of the conjunctival sac may be reduced to 88° or 94° F., accordingly as the lids are little or much swollen ; the temperature of the surface of the lid is kept at about 40° F. Cold is best applied in the following manner: Upon a block of ice square compresses of patent lint are laid, which in turn are placed upon the swollen lids, and as frequently changed as may be needful to keep up a uniform cold impression. This is preferable to the use of small bladders containing crushed ice, which are not advisable for infants. Sometimes the cold may be used continuously, sometimes for periods of half an hour at a time. The experience of clinicians—for example, Stellwag,[3] A. Graefe,[4] and Hirschberg[5]—in this early stage, where the reaction is high and the case sthenic, is favorable to the use of some form of cold, in the judgment of the author best applied by

[1] *Wien. med. Wochenschr.*, 1885, Nos. 30, 31, 32.

[2] *Medical Record*, July 24, 1886.

[3] *Allg. Wien. med. Zeitung*, Nos. 15–18, 1881.

[4] *Volkmann's Sammel-klin. Vortraege*, No. 192, 1881.

[5] *Berlin. klin. Wochenschr.* No. 33, S. 525.

the means just described. Hot fomentations are occasionally better than cold, especially when corneal complications exist; and some American observers (Freyer and Heyl) apply them at all stages. These should be composed of squares of antiseptic gauze wrung out in carbolized water at a temperature of 120° F. and frequently changed.

As soon as the discharge becomes abundant, and especially when its character is creamy, its constant removal must be assiduously practised: the lids are to be gently separated, the secretion wiped away with bits of moistened lint or absorbent cotton, and the conjunctival sac freely irrigated with an antiseptic solution. For this purpose a saturated solution of boric acid or one of corrosive sublimate, a grain to the pint, may be employed. The cleansing process must be repeated at least every hour day and night, but if necessary should be much more frequently used. Instead of applying the solution with the ordinary pipette, ingeniously devised lid-irrigators have been constructed by Story and other surgeons. The question is often raised whether bichloride of mercury or boric acid should be employed as the irrigating fluid. A solution of corrosive sublimate, 1 : 10,000, will materially retard the vitality of the coccus. Weeks has shown that the same drug in the strength of 1 : 500 will destroy the vitality of staphylococcus pyogenes aureus, which, it should be remembered, is present in gonorrhœal pus, in forty-five seconds, and in a strength of 1 : 2000 in ninety seconds; hence this would seem the most rational remedy. Bacteria, however, in the presence of albumin have the power of reducing bichloride of mercury to calomel and of nullifying its antiseptic properties (Andrews). The gonococci penetrate deeply into the conjunctiva, and consequently are with difficulty destroyed by a germicide, and, moreover, a very strong solution of bichloride is irritating and may depress the nutrition of the cornea and tend to produce ulceration. Hence it cannot be looked upon as a germicide in the ordinary sense of the term, but should be regarded as a cleansing agent—a function which is practically performed with equal ability by boric acid (which is not germicidal, but slightly astringent), without any of the dangers attendant on the corrosive chloride.

Many drugs other than those mentioned have found favor with surgeons; for instance, alum (8 grains to the fluidounce), sulphate of zinc (2 grains to the fluidounce), carbolic acid in $\frac{1}{2}$ to 5 per cent. solution, weak solutions of nitrate of silver, the alcohol and bichloride-of-mercury solutions advocated by Mules,[1] iodoform, creolin in 1 per cent solution,[2] and cocaine, either dropped frequently upon the conjunctiva or introduced in the form of the salve (Haga).

[1] *British Medical Journal*, Feb. 4, 1888.

[2] Consult *Münch. med. Wochenschr.*, No. 26, 1888; *Centralblatt f. prakt. Augenheilkd.*, March, 1888.

Peroxide of hydrogen has been largely advocated in blennorrhœas of the conjunctiva, and certainly its power as a cleansing agent is undoubted. In the judgment of the author, however, while an excellent adjuvant it should not be relied upon to the exclusion of other methods. Braeuerlein[1] has advocated the continuous use of compresses saturated with a solution of salicylic and boric acid, and the instillation two or three times a day of a solution of benzoate of sodium, 1 : 20. His testimony in favor of this treatment is very strong. In recent times pyoktanin, 1 : 1000, originally introduced by Stilling,[2] has had many advocates on account of its supposed efficiency as a pus-killer. French observers, however, like Valude and Vignal,[3] have shown that the violet pyoktanin is more powerful than the yellow, but that it is far inferior to the bichloride of mercury as a germicide. The yellow pyoktanin was found utterly inefficient in all cases of ophthalmia neonatorum; indeed, it seemed to increase the secretion. The reports of Carl, Braunschweig, and Bayer declare that the excellent qualities which have been attributed to this dye do not exist, but that, in addition to the discolorations, positively harmful results may follow its application even to the extent of an irritation which deepens into a croupous inflammation. Observations made in the Philadelphia Hospital by Gould[4] and by the author[5] tend to show that its application was extremely limited, and that it was valueless in certain forms of purulent ophthalmia. Indeed, recent testimony has been distinctly against this drug, with the single exception, perhaps, of Wanscher,[6] who is outspoken in its praise.

Each of the solutions has its advocate; for instance, zinc in the form of the chloride has been regarded as a specific, and C. Allen Lambert[7] has given very decided evidence in regard to its value, preferring to use it in a mixture combined with morphine and in a strength of 2 grains to the ounce. Carbolic acid is uniformly antiseptic under almost all conditions, and certainly a solution of 1 : 200 is a useful addition to the treatment.[8]

It seems likely that iodoform is not effectual unless it is first decomposed, and, according to Dr. Andrews, the micro-organisms of gonorrhœal pus do not appear to possess this power. Moreover, Weeks has shown that iodoform in dry powder requires twelve hours to influence the vitality of the staphylococcus pyogenes aureus, and hence its use

[1] *Protokoll. d. X. Vers. d. Aerzte Unterfrankens*, 1880.
[2] *Revue générale d'Ophthalmologie*, ix., April, 1890.
[3] *Archive d'Ophthal.*, Sept., Oct., 1890.
[4] *University Medical Magazine*, vol. iii.
[5] *Ibid.*
[6] *Therap. Monatsheft.*, Feb., 1891.
[7] *Archives of Ophthalmology*, vol. ix. No. 4.
[8] Consult Burnham, *Royal London Ophthalmic Hospital Reports*, vol. x., June 2, 1881.

in the treatment of purulent ophthalmia is of doubtful advantage. In this connection the testimony of Lange,[1] who treated 6 cases of blennorrhœa neonatorum exclusively with iodoform in powder, which he applied three to four times in twenty-four hours to the inside of the everted lids, is interesting. After six days he was obliged to use a nitrate-of-silver pencil to subdue the enormous granulations which his treatment had called into existence.[2]

The value of the frequent use of weak solutions of nitrate of silver is attested by a number of observers. Andrews[3] is particularly strong in his evidence. His method briefly is the following: Rest in bed; a competent nurse; protection of the sound eye; uninterrupted application of iced compresses; and frequent irrigation, preferably with a fountain syringe and a saturated solution of boric acid. In addition, in severe cases a 2 per cent. solution of nitrate of silver should be dropped in the eye from one to three times a day according to the indications.

The local application of nitrate of silver to the conjunctiva of the everted lids must not be employed in the earlier stages before free discharge is established, nor in those cases, no matter what the stage, where the lids are tense and board-like and the surface of the conjunctiva covered with a gray film or a positive false membrane. It is perfectly true that very many observers, notably Carre[4] and Abadie,[5] advocate the use of nitrate of silver even in the beginning of blennorrhœa, the latter observer in this connection beginning the cauterization of the conjunctiva from the first day of the inflammation every twelve hours. This is not in accord with the highest experience on this side of the water, and most observers will agree with Noyes that nitrate of silver has no place during the period of invasion and of copious thin, gruel-like, puriform secretion. When the secretion is free and creamy, when the lids are relaxed, when the conjunctiva is dark red and puckered into papilla-like excrescences, the time for its application has come. Once a day the conjunctiva should be brushed over with a solution, 10 or 20 grains to the ounce, its surface first having been carefully freed from any adherent discharge and all excess washed away with water. In severe cases the mitigated stick, and even the solid pencil, of nitrate of silver may be employed. Great care should be taken to neutralize the excess with a solution of common salt. So long as the discharge is abundant the use of the caustic is indicated.

The efficiency of nitrate of silver depends upon the fact that it is a

[1] *Petersburg. med. Wochenschr.*, S. 82, 1882.

[2] Fialkowsky declares that iodoform is absolutely contraindicated in blennorrhœa.

[3] *Transactions of the American Ophthalmological Society*, 1886, and *New York Medical Journal*, June 21, 1890.

[4] *Gaz. des Hôp.*, No. 10, 1882.

[5] *Ibid.*, 1882.

germicide, a superficial caustic, and an alterative.[1] Andrews[2] found that a 2 per cent. solution of the drug destroyed the infective properties of gonorrhœal pus in from six to ten seconds, and Weeks[3] extinguished the vitality of staphylococcus pyogenes aureus and typhoid bacillus in four seconds with a solution of nitrate of silver, 1 : 10, and in eight seconds with a 1 : 50 solution.

The treatment of corneal complication, made manifest by the appearance of a haze in this membrane, generally includes the use of a solution of atropine dropped into the eye two or three times daily. The formation of a marginal ulcer, bringing with it the danger of perforation, is best treated by the use of a solution of sulphate of eserine. The use of this drug in the treatment of corneal ulcers, originally introduced by De Wecker, has certainly been the means of arresting the sloughing process in various types of corneal inflammation, not the least important of which are those which occur in connection with purulent ophthalmia. It must not be used too strong, lest it produce iritic complications; $\frac{1}{6}$ to $\frac{1}{2}$ grain to the ounce is quite sufficient. An excellent rule is to employ it during the day-time every three or four hours, and to use atropine at night.

When the vitality of the cornea is threatened or the surface of the conjunctiva is covered with a gray film, better results will follow the use of hot applications than of cold.

If perforation actually occurs, an attempt may be made to reduce this by means of eserine or atropine according to its situation, and if not successful surgical measures are to be considered. Ordinarily, in the height of a purulent ophthalmia surgical interference is not possible unless the lens present in a large central perforation of the cornea, when it may be removed. After the discharge has ceased and the conjunctiva has become smooth, the result of corneal perforation is to be treated, and the measures elsewhere described applicable to nebulas, leucomata, or staphylomata are appropriate. Impending corneal perforation under ordinary circumstances, and unconnected with a purulent inflammation of the conjunctiva, is often managed upon surgical principles. Under present circumstances it seems wise not to attempt these; indeed, meddlesome surgical interference in this respect may precipitate a panophthalmitis. An exception to this rule should be stated in favor of the actual cautery, which under some circumstances has arrested a corneal inflammation such as the one under discussion. One or two very brilliant examples have occurred in the author's practice.

If one eye alone is affected, suitable protection to the sound eye should be provided. In ophthalmia neonatorum, unfortunately nearly

[1] Consult also Openheimer, *Archiv f. Gynuekol.*, vol. xv. No. 1, and Kries, *Wiener med. Wochenschr*, 1885, Nos. 30, 31, 32.

[2] *Loc cit.*

[3] *Medical Record*, Aug. 3, 1889.

always, however, both eyes are inflamed. Such protection may be accomplished by an antiseptic bandaging of the uninflamed organ. Buller's shield is difficult of application in infants. Fränkel[1] has suggested the daily use in the unaffected eye of a drop of a 2 per cent. solution of nitrate of silver.

From the evidence thus presented it seems fair to assume that cold applications, for which under the conditions named hot fomentations are substituted; absolute cleanliness; frequent irrigation with antiseptic solutions (boric acid) or weak germicidal solutions (bichloride of mercury or carbolic acid); nitrate of silver at the proper stage; and atropine or eserine, according to circumstances, if corneal ulceration appears, will meet with the best results. The attendants must be impressed with the fact that upon their faithful carrying out of directions and upon their unremitting care much of the hope of bringing the case to a successful termination depends. The attendants must further be impressed with the contagious nature of the pus. All bits of rag and pledgets of lint used in the treatment must be destroyed, and the hands of those engaged must be thoroughly washed and then disinfected with a solution of bichloride of mercury after each treatment.

Gonorrhœal Ophthalmia.—The second type of purulent ophthalmia, or that ordinarily known as *gonorrhœal ophthalmia*, appears in adults, and usually can be traced to its source—the contagion from an acute gonorrhœa or a gleet or from an eye similarly affected. The first symptoms appear from twelve to forty-eight hours after inoculation, and resemble those already recited in connection with the same disease occurring in the newly born. The vitality of the cornea is in constant danger, and complications in this membrane may arise during the height of the attack or when convalescence apparently is established. They consist either in ulcers or a more or less dense opacity, which may be followed by ulceration or arise independently of this condition. If perforation occurs, the phenomena described on page 937 are likely to ensue, and even without perforation iritis, cyclitis, and secondary disease of the uveal tract may develop. Gonorrhœal ophthalmia reaches its climax in about ten days, and then gradually subsides in from one to two months, or it may pass into a chronic type and may be one of the forms of chronic blennorrhœa.

Treatment.—This includes the same principles and practice described in connection with ophthalmia neonatorum, but requires certain modifications suggested by the adult age of the majority of the cases.

In the beginning, when the inflammatory reaction is of high degree, a few leeches may be applied to the temple. If during the stage when

[1] *Klin. Monatsbl. für Augenheilkunde*, Feb., 1889.

the swelling of the lids is so great that their pressure threatens to destroy the cornea, the outer canthus may be divided (canthotomy). This acts in a twofold manner, by relieving pressure and by depleting the engorgement through the loss of blood occasioned by the incision. Repeated incisions of the hard rim of chemotic conjunctiva which surrounds the cornea will also bring relief. In desperate cases some operators (Critchett [1] and Fuchs [2]) have not hesitated to split the lid vertically and stitch the divided portions to the brow, restoring them by a plastic operation after the disease had subsided.

Cold may be applied with compresses in the manner described, or continuously, if need be, with Leiter's tubes. Under the circumstances already described hot applications may be substituted.

The local applications include the antiseptic lotions and other astringents described in connection with Ophthalmia Neonatorum, in addition to which a drug which has found favor with many may be mentioned—namely, permanganate of potassium. A solution 1 : 100 is prepared, and from this a sufficient quantity is taken to alter half a pint of water to a deep-red color, and the lotion thus prepared used in the ordinary manner for cleansing the conjunctival cul-de-sac. Much testimony in regard to the value of permanganate of potassium thus employed is at hand. Stellwag, who was accustomed to use this in a 3 per cent, solution, irrigated the eye every three or four hours.

At the proper stage nitrate of silver is the best remedy, and the directions which were given concerning the time of its application in the purulent ophthalmias of infants are here applicable. Generally, it is unnecessary to use it in a strength greater than 10 or 15 grains to the ounce, but when the granulations are exuberant the mitigated or solid stick at times will alone control the process. The great secret of the application of this drug is that it shall be thoroughly done. All flakes of lymph and adherent pus are to be carefully wiped away, and not merely the anterior portion of the palpebral conjunctiva should be exposed, but also the retrotarsal folds.

On the appearance of any of the types of ulceration of the cornea the surgeon must decide between atropine and eserine. No question arises if the iris is involved, but in the absence of such complication the action of eserine is more favorable. If the eserine produces pain, this may be mitigated by the employment of a few drops of the ordinary atropine solution at night. Corneal involvement does not contraindicate the caustic applications to the lids, only these must be made with great care to avoid any pressure upon the eyeball.

Threatening perforation suggests the operation of paracentesis, which is often recommended, but owing to the objections already urged against

[1] *Lancet*, April 3, 1880. [2] *Centralbl. f. prak. Augenheilk.*, 1881, p. 198.

its performance is not always applicable. A substitute for this operation is the use of the actual cautery. If perforation has taken place, the natural procedure of seizure and excision of the prolapsed iris is not always safe, lest it open a way for the entrance of infecting material to the deeper structures of the eye. A small prolapse peripherally situated may subside under the vigorous application of eserine; when centrally placed, under the use of atropine. The final outcome of the case will depend upon the extent of the corneal involvement, and the treatment of a remaining leucoma, staphyloma, or shrunken ball will require, according to circumstances, iridectomy, abscission, evisceration, or enucleation.

Gonorrhœal ophthalmia is to a certain extent amenable to general treatment, and a vigorous individual may with propriety be brought under the influence of mercury, preferably by inunctions, in the beginning of the disease and when there is high-grade inflammatory action. Debilitated patients require quinine, iron, strychnine, and milk punch, the last if there is any tendency to sloughing of the cornea. Poor circulation calls for digitalis or nux vomica. It is very certain that these measures favorably modify the failing nutrition of the cornea. The pain, which is often severe, may be allayed with morphine; indeed, the latter drug has a good influence on the sloughing process. It is a mistake in serious forms of this disease to depend alone upon local measures.

All of the drugs which have been mentioned in connection with Ophthalmia Neonatorum have been used in gonorrhœal ophthalmia, and much evidence is at hand from various reporters in regard to their efficacy. For example, Burnham[1] has advocated the free and frequent use of carbolic-acid lotion, 1 : 20, believing that it acts beneficially on the cornea when perforation is threatened. E. A. Browne[2] uses a 2 per cent. phenol, and afterward a 2 per cent. trichlor-phenol, solution for irrigation; Simi[3] speaks favorably of resorcin in suppurative inflammation of the conjunctiva; Brame[4] has recommended nascent iodide of silver in purulent and catarrhal conjunctivitis—a treatment which is also endorsed by Sedan;[5] Bader[6] claims good results for the use of a salve consisting of 1 grain of a red precipitate and $\frac{1}{5}$ grain of atropine to an ounce of vaseline; F. M. Wilson[7] highly recommends the use of vaseline in gonorrhœal conjunctivitis, the ointment being freely introduced in the conjunctival cul-de-sac—a practice which is also endorsed by so high an authority as Noyes.

[1] *Royal London Ophthalmic Hospital Reports*, vol. x., 1881.
[2] *British Medical Journal*, Jan. 10, 1885, p. 68.
[3] *Annali di Ottal.*, vol. xii. 1, 1883.
[4] *Gaz. des Hôp.*, Sept., 1882.
[5] *Rec. d' Ophthal.*, 1883, No. 5, p. 264.
[6] *Lancet*, Oct. 14, 1882.
[7] *Trans. Amer. Oph. Soc.*, 1891.

The chief reliance should be placed upon the action of continuous cold in the early stages, scrupulous cleanliness, eserine or atropine, according to the circumstances, in corneal ulceration, and nitrate of silver at the proper time. Much more frequently than in ophthalmia neonatorum one eye alone is affected, generally the right one; hence the protection of the sound eye becomes a matter of great importance. A number of methods are suggested: Buller's shield is made by introducing a watch-glass into a piece of adhesive plaster, which is then securely fastened over the eye in such a manner that the crystal comes directly in front of the cornea, while the edges of the plaster are secured to the side of the nose, brow, temple, and cheek. Howe[1] protects the unaffected eye with a shield of mica, which is accurately adapted to the nose, brow, and cheek of the sound eye by means of adhesive straps. Stellwag recommends that the well eye be protected with a collodion bandage. Under all circumstances Buller's shield is most convenient.

Pseudo-membranous Ophthalmias.

These cases are characterized chiefly by the deposition of a false membrane, and are generally known under the single term *plastic ophthalmia.* Two chief varieties are seen: croupous and diphtheritic ophthalmia, by many authors considered different types of the same disease, but inasmuch as they exhibit very decided clinical differences they will be given a separate description.

Croupous Ophthalmia.—This is a rare disease, characterized by a severe, usually painless, swelling of the lids, a membranous exudation upon the surface of the conjunctiva, and a scanty sero-purulent discharge. No distinct causes are known, although there is some relation between this affection, scrofula, eczema, and a definite age of childhood. It is never found among the new-born and never among grown-up people. The patient at the same time may be suffering from a similar condition of the upper respiratory tract. This disease must not be mistaken for cases of purulent or gonorrhœal ophthalmia, in which flakes of false membrane form upon the conjunctiva. The disease is not contagious.

Knapp[2] recommends the uninterrupted application of iced compresses and frequent removal of the discharge with a weak solution of chloride of sodium or chlorate of potassium. Later, astringents may be utilized—for instance, nitrate of silver—but ordinarily and in the earlier stages this is not advisable, as Horner states that the only case in which he saw corneal ulceration was where this drug was employed. Lotz,[3] who has well described the affection, considers isolation of the

[1] *Buffalo Medical and Surgical Journal,* Feb., 1880.

[2] *Archives of Ophthalmology,* vol. xiv., 1882.

[3] *Ueber Conjunctivitis Crouposa,* Inaug. Dissert., Basel, 1887.

affected child unnecessary, but recommends bandaging of the well eye and the application several times a day of a warm solution of lead-water. Kroll[1] advises chalk and water in croup of the conjunctiva, and finds it very efficient. Other local applications are quinine directly upon the surface of the lids, iodoform salve in strength of 1 : 10 (Galezowski,[2] Fourquette), and, after the removal of the membrane, subnitrate of bismuth, which in one instance in the author's hands appeared to be very efficient. Occasionally the membrane is re-formed with singular persistency. If corneal complications arise, these must be treated in the manner already described.

Diphtheritic Conjunctivitis.—This is characterized by a board-like, very painful swelling of the lids, a scanty sero-purulent or sanious discharge, and an exudation within the layers of the conjunctiva which leads to the death of the invaded tissues, and tends by spreading to the ocular conjunctiva and by pressure to destroy the cornea. The disease is contagious, and may originate from a similar case or arise in the course of a purulent conjunctivitis. It has occurred, though rarely, with ophthalmia neonatorum. In certain localities in the south of France and the north of Germany it is endemic. It sometimes appears in connection with eczema of the face, and the most severe forms of the disease are seen during epidemics of diphtheria.

The symptoms consist essentially of those related in the definition already given. The disease often begins as an ordinary purulent ophthalmia, and then goes on to the characteristic appearances produced by the formation of a dull, grayish-red false membrane, which when torn off leaves a raw and bleeding surface beneath if the process is superficial, but if it is deep the subjacent tissue is pale and infiltrated, and when incised anæmic and lardaceous. More than in any disease of the eye the cornea is threatened with destruction, and in fact in any fully-developed case it practically never escapes unharmed.

During the earlier stages the best local measures are cold compresses applied in the manner already described. If corneal involvement is imminent or already at hand, hot compresses are to be employed for ten to twenty minutes at a time, or continuously. The eyes may be frequently cleansed with the various solutions already recommended. Besides the collyria mentioned, solutions of salicylic acid and carbolic acid have found favor. Vossius[3] recommends a 4 per cent. solution of salicylic acid and glycerin to be painted every half hour upon the conjunctiva; Fuchs[4] brushes the conjunctiva with a 1 per cent. solution of carbolic acid; Fieuzal[5] uses an application of lemon-juice, which is then washed

[1] *Berlin. klin. Wochenschr.*, 1884.
[2] *Rec. d'Ophthalmolog.*, June, 1882.
[3] *Klin. Monatsbl. f. Augenheilk.*, Nov., 1881.
[4] *Causes and Prevention of Blindness*, 1885.
[5] *Bull. de la Clin. Nat. Ophth.*, vol. vi., No. 2, p. 67.

away with a 2 per cent. solution of nitrate of silver; and Abadie[1] speaks of the application of citric-acid ointment as preferable to antiseptics. Burchardt[2] is an advocate of warm applications and pencilling the diphtheritic spots with bichloride of mercury 1 : 1000. Tannin and glycerin find an advocate in Vennerman. Galezowski has employed oil of cade 1 : 10; Tweedy[3] speaks well of quinine; Burgmeister of the flowers of sulphur; and Mayweg and others of iodoform. The author tried in one case powdered boric acid; the result was not favorable. Internally, the most useful remedies are quinine, iron, and mercury; the former should be given in suppositories, the iron as the tincture of the chloride, and the mercury either as calomel or as the bichloride. Barette[4] found benefit in some cases from the subcutaneous injection of pilocarpine. Milk punch may be added if there is depression, and with naso-pharyngeal diphtheria the proper local measures are to be used, especially, as Jacobi[5] has advised, nasal injections of bichloride of mercury, 1 grain to the pint. The usual protection of the sound eye is indicated, and the patient should be isolated, especially if other children are at hand who are suffering from facial eczema or any form of catarrhal ophthalmia.

Phlyctenular Ophthalmia, or that disease of the conjunctiva in which a number of white-topped vesicles situated chiefly upon its palpebral portion, appear, is so closely allied to phlyctenular keratitis that further discussion of it will be found under diseases of the cornea.

Follicular Ophthalmia.—This is an affection of the conjunctiva associated with the presence of small pinkish prominences in the conjunctiva, chiefly located in the retrotarsal folds and usually arranged in parallel rows. The disease arises under the influence of bad hygienic surroundings, and often appears as an epidemic in pauper schools, asylums, and prisons, but is also very commonly seen in a mild form among children.

There is very considerable difference of opinion as to whether this disease should be placed in a separate category from granular ophthalmia, many authors looking upon it as an early stage of trachoma. Bacteriologically, the two diseases are considered identical. No doubt many transitional forms appear, but, clinically at least, follicular ophthalmia differs widely from true granular lids.

The subjects of follicular ophthalmia complain of slight dread of light and inability to perform any close work. Inspection of the con-

[1] *Bull. de la Clin. Nat. Ophth.*, vol. vi. No. 2, p. 67.
[2] *Charité Annalen*, 1886.
[3] *Lancet*, Jan. 24, 1880.
[4] *Archiv. d'Ophth.*, vol. ii. No. 2.
[5] *Proceedings of the Philada. County Medical Society*, 1888.

junctiva reveals numerous round elevations, chiefly along the fornix. These are the tumefied lymph-follicles. After the disappearance of the enlarged follicles the conjunctiva regains its natural state. Cicatricial changes do not occur, and neither are there corneal complications. In these respects the disease differs from trachoma.

The patient should have the best hygienic surroundings and any tonic regimen that may be indicated. Locally, boric acid, weak bichloride solution, and the occasional use of iodoform, aristol, and subnitrate of bismuth and calomel in equal parts, are the best measures. A salve of ½ grain of sulphate of copper to the drachm of vaseline has been highly extolled. If refraction error exists, appropriate glasses should be ordered, because uncorrected ametropia aggravates the disorder.

The surgical treatment of follicular ophthalmia includes the measures which will be described in connection with Trachoma. This becomes a necessity if the disease establishes itself as an endemic in asylums, and excellent results in eradicating follicular ophthalmia under these circumstances have been reported by numerous observers.[1]

Granular Ophthalmia.—This disease, variously called granular conjunctivitis, Egyptian ophthalmia, and trachoma, is an inflammation of the conjunctiva characterized by the formation of rounded granulations, which after absorption leave cicatricial changes. It is commonly studied in two forms—acute granulations and chronic granulations

The former may arise primarily under the influence of bad hygienic surroundings, and appear endemically in institutions where inmates are crowded together.

The symptoms are those of an intense conjunctivitis associated with hypertrophy of the papillæ and the development of roundish granulations. There is little secretion at first; later, a muco-purulent discharge appears, and the process terminates by the absorption of the granulations, or may run into the chronic form.

The treatment of acute granulations is governed by the principles which have been described under the Acute Ophthalmias, and in this inflammatory stage soothing local remedies are indicated, and not the astringent and caustic applications which are required in the chronic disease. Neutral acetate of lead in 2 per cent. solution is recommended by Sattler; if secretion is present, nitrate of silver. After inflammatory symptoms subside the remaining granulations are treated by the methods which are described with Chronic Trachoma.

Chronic granular lids, or trachoma, results from the imperfect disappearance of an acute granulation, but much more frequently arises

[1] Consult Vossius, *Therap. Monatsheft.*, June and July, 1889.

as a primary disorder. Children are less commonly attacked than adults, and negroes enjoy a comparative immunity. The Irish, Jews, North American Indians, and Eastern races are strongly predisposed to this affection.

There is no constitutional cause for granular lids, although some observers maintain that there must exist in the form of a dyscrasia a predisposition to this disease. Dwellers in certain regions where low and marshy lands abound are especially prone to be affected, while an altitude of one thousand feet confers a comparative immunity. A large amount of evidence has accumulated indicating the dependence of granular lids upon the presence of a special form of micro-organism—the trachoma coccus—the identity of which, however, has not been established. The essential features of trachoma are the "granulations," which must not be confounded with the surface granulations seen during the course of the disease. Two views have been entertained concerning the nature of the bodies: one, that they are new growths of special pathological character, and the other, that they are derived from the natural lymphatic follicles of the part. It seems likely, so far as true trachoma is concerned, that the former view is the correct one.[1]

Systematic writers recognize the following clinical varieties of trachoma:

(1) Papillary trachoma, in which the "trachoma bodies," or follicles, are sparsely present and hidden from view by hypertrophied papillæ.

(2) Follicular trachoma, in which the presence of the "follicles" is the prominent characteristic. Some authors consider follicular ophthalmia a variety of this type.

(3) Mixed trachoma, in which the bodies, or "granulations," lie among inflamed and hypertrophied papillæ, but are not hidden by them. This type is often spoken of as diffuse trachoma.

It is essential to remember that the treatment of chronic trachoma includes—(1) Measures to facilitate the absorption of the "granulations," and induce cicatrization with the least possible damage to the area in which these bodies exist. Hence the various remedies must not be of such character that they will produce scars more harmful than the original malady. (2) Measures to relieve the complications and sequels of granular lids—pannus or vascularization of the cornea, atrophy and shrinking of the conjunctiva, and trichiasis and entropion. It is convenient to divide the treatment into three departments—medicinal, operative, and general.[2]

[1] Consult Moauro, *Annali di Ottalmologia*, anno 19, Lasc. 5 and 6, 1891; also a paper by Burnett on "Recent Views in the Pathology of Trachoma," *Ophthalmic Record*, Sept., 1891, p. 79.

[2] Professor Sattler's monograph, *Die Trachombehandlung einst und jetzt*, Berlin, 1891, contains a masterly review of the various methods which have been employed in the

In papillary trachoma the first indications are to subdue the hypertrophy of the papilla and the secretion. This is accomplished by using as a collyrium boric acid or bichloride of mercury (1 : 8000), and touching the everted lids with solution of nitrate of silver (2 per cent.) if there is much secretion. Later, the use of a crystal of alum or sulphate of copper or tannin and glycerin (gr. xxx to f℥j) is efficient.[1] These applications should be made daily and used interchangeably according to the indications. Tannin may also be employed as dusting powder, a useful combination, according to Wicherkiewicz,[2] being tannin 1 part and boric acid 3 parts. This mixture is endorsed by Sattler, who uses the drug in the form of a salve (1 : 3 : 10). Minor[3] prefers the use of boric powder alone, especially in fresh granulations.

In follicular trachoma the measures described in connection with Follicular Ophthalmia (page 947) are applicable, in addition to those which have just been mentioned. This variety is especially amenable to the surgical interference which will presently be described.

In chronic diffuse trachoma, or the mixed varieties of granular lids, a host of local remedies has been called into service, notably sulphate of copper, nitrate of silver, strong solutions of bichloride of mercury, and boroglyceride.

Sulphate of copper has long enjoyed the foremost reputation, and, in the form of verdigris, associated with other substances, was employed by the ancient Egyptians, 1500 years B. C., in the treatment of those affections of the eyes which were the analogues of the present trachoma, even if they were not identical with it.[4] It should be employed in smooth crystal, with which the thoroughly everted lids are touched once a day and the surfaces then washed with water. The application is painful, and there is no objection to the instillation of cocaine. It is used in all stages, but is most beneficial in chronic cases after cicatrization has begun.[5]

treatment of trachoma, and is particularly interesting in its historical allusions. The reader who desires to pursue this subject is referred to this paper, to which the author is indebted for many of the references contained in the following paragraphs.

[1] Tannic acid, so much employed in the treatment of granular lids, has an interesting history, according to Sattler (*loc. cit.*). It was recommended in 1829 by Eble, who used it in the form of an extract of galls mixed into a thick consistence with water. In 1859, Hairion employed it in concentrated solution incorporated with gum arabic. Hirschberg in 1871 endorsed it as the mildest of topical remedies in this disease, applying a watery solution with a brush; while Wolfe, ten years later, advocated its use in the form of a syrup.

[2] *Klin. Monatsbl. f. Augenheilk.*, 1886, p. 492.

[3] *N. Y. Monthly R.*, Feb., 1882.

[4] *Aegypten. Geschichtliche* (Studien eines Augenarztes von J. Hirschberg), Leipzig, 1890, p. 40, quoted by Sattler, *loc. cit.*

[5] Instead of the ordinary crystal of sulphate of copper, a stick of *lapis divinus*, which consists of alum, nitrate of potassium, and sulphate of copper fused together, and camphor equal to one-fifteenth of the whole added, may be used.

Nitrate of silver, in 1 to 2 per cent. strength, is a suitable remedy whenever secretion is present. After its application the usual precautions to neutralize the excess are needed, especially if, as is proper in cases of great thickening and papillary hypertrophy, it is used in the form of the mitigated stick.[1]

In recent times strong solutions of bichloride of mercury have been warmly recommended in the treatment of trachoma, and in many respects are the best of the local applications. Guaita[2] advocated bichloride of mercury 1 : 500, applied with a camel's-hair brush or cotton mop, in mild forms, and 1 : 400 in severe forms, considering the remedy distinctly specific. Staderini[3] fully endorses the method, and Arnauts,[4] who says that Romiée has employed corrosive sublimate in this way since 1872, advises that twice a week the affected conjunctiva be brushed over with a solution 1 : 120 or 1 : 100, and three times a day 2 drops of a collyrium of the same drug, 1 : 500, be instilled into the eye.[5] Dujardin[6] records good results with the application of a solution of 1 part of sublimate to 10 of alcohol and 240 of water; and Wicherkiewicz[7] and Lapersonne[8] recommend very strong solutions of the sublimate, .5 to 1 per cent. Excellent results with the bichloride-of-mercury treatment of granular lids have been recorded in this country by Ayres[9] and by the author,[10] who has found the following method of use: Every other day the everted lids are touched with a solution of the drug 1 : 500 or 1 : 300, according to circumstances, and thrice daily a tepid collyrium, 1 : 7000, is freely instilled.

Weak solutions of bichloride (1 : 3000), used every three hours for twenty minutes, are advocated by Noyes[11] and also by Michel, who employs the drug in the form of a salve (0.003 to 10.0 of vaseline).[12]

Boroglyceride, from 20 to 50 per cent. strength, is a useful remedy, and is warmly recommended by Turnbull. It has been employed in all stages, but is peculiarly applicable when the granulations are disappearing and cicatrization is becoming more complete, with a tendency

[1] According to Sattler, V. Hasner in 1847 and Desmarres and Cunier in 1845 were among the first to use nitrate of silver incorporated with nitrate of potassium.

[2] *Annali di Ottalmolog.*, anno xv., p. 295–317; *ibid.*, anno xviii., p. 356.

[3] *Ibid.*, xvi. p. 403. [4] *Annales d'Oculistique*, Jan., Feb., 1889, p. 51.

[5] A solution 1 : 120 or 1 : 100 is unnecessarily strong, and will cause irritation; 1 : 500 is sufficient.

[6] *Rec. d'Ophth.*, 1884, No. 1. [7] *Soc. franç. d'Ophthalm.*, April, 1886.

[8] *Bullétin méd. du Nord*, 1889.

[9] President's address Section of Ophthalmology, Amer. Med. Assoc., Nashville, 1890.

[10] *Univ. Med. Mag.*, vol. ii. p. 557. [11] *Diseases of the Eye*, p. 323.

[12] Sattler mentions as an interesting historical fact that Buzzi in 1825 used in contagious ophthalmia a sublimate solution (1 grain to 5 ounces of water). In 1784, Conradi employed the solution long afterward known as "Aqua Conradi," in which bichloride of mercury formed the essential part.

to dryness. It seems to lessen the tendency to the production of a xerotic condition of the conjunctiva.[1]

In addition to the remedies which have just been described the following drugs have found favor:

Dixon [2] praises the local application of liquor potassii to the granulations. Iodoform has been extensively employed, both in the form of the powder and salve, either by itself or in conjunction with the other remedies; for example, Kazaurow [3] prefers the iodoform ointment in conjunction with the copper crayon or a solution of nitrate of silver. Mooren [4] has reported the disappearance of trachoma after the use of iodoform rubbed upon the lids in the form of the collodion (5 : 30), a salve of the same drug being inserted into the conjunctiva. Brettaur,[5] in a contribution on the use of iodoform in conjunctival affections, recommended that the drug be dusted into the eye in acute granulations. In the discussion Horner, Leber, Nieden, and other surgeons testified as to its use in trachoma and other diseases of the conjunctiva. In spite of this testimony, and much more that could be cited, the drug has not at the present time found very much favor, and Sattler concludes that it has seen its day in the therapeutics of trachoma. Instead of iodoform, there is a good deal of evidence as to the value of aristol, to which reference has already been made in Follicular Ophthalmia. Certainly in some of the types of granular disease it seems to have a mild curative influence.[6]

Carbolic acid has met with considerable success in the hands of some surgeons. Collins [7] employs a pure carbolic acid just liquefied, with which he touches the everted lids, and washes away the excess with a copious irrigation of water. Fieuzal [8] has used a 2 per cent. solution of carbolic acid with advantage, and Auvray [9] recommends bathing with phenic-water 1 : 500. Finally, carbolic acid has been used in the form of a subconjunctival injection in granular trachoma, 2 or 3 drops of a 2 per cent. solution being introduced by means of a Pravaz syringe, the testimony of Schtschepkin [10] being that after two or three injections of this character the granulations disappeared.[11]

[1] *Medical News*, Feb. 7, 1891.
[2] *Diseases of the Eye*, 3d ed., p. 56.
[3] *Wratsch*, 1883.
[4] *Fünf Lustra der Ophthalmolog. Prakt.*, 1882.
[5] *Bericht der Heidelberg. Ophth. Gesellsch.*, 1881.
[6] See an article by Wallace, *University Medical Magazine*, 1891.
[7] *Royal London Ophthalmic Hospital Reports*, vol. xi., 1887.
[8] *Thèse de Paris*, 1884.
[9] *Ibid.*, 1883, abstr. in *Knapp's Archives.*
[10] *Wratsch*, 1886, No. 42, abst. *Arch. of Ophthalmology.*
[11] Sattler, commenting on this rather extraordinary treatment, remarks that fortunately it found no acceptance, not only because, as one observer points out, it is intensely painful, but because it had no influence in stopping the development of the follicles, while the introduction of the injections was followed by the development of scars.

Resorcin in 1 to 3 per cent. solution, put up with glycerin, has been recommended even after other remedies have failed.[1]

Panas introduced the use of beta-naphthol in the form of a salve (0.1 to 0.3 to 30.0 vaseline), the conjunctival sac at the same time being irrigated with a weak solution of the drug, and reports good results. Confirmatory evidence of the value of this treatment comes from Delagénière,[2] and Dupont [3] recommends both a lotion and a salve to be used with massage movements. He prefers, however, alpha- to beta-naphthol. No doubt the treatment with naphthol is efficacious in certain cases, but it is by no means free from considerable irritation.

Chromic acid has had a few advocates in recent times, notably Darrier.[4] He advises that there shall be an alternate application of chromic acid and sulphate of copper, especially in the tough, leather-like granulations.[5] Quinine has been used in the form of a collyrium by Nagel,[6] and by Prout [7] and by Bader [8] in the form of a powder.

The use of boric acid in a powder in the treatment of this disease has been referred to, and some surgeons employ various indifferent pulverized substances dusted directly upon the affected area, and massage performed by means of the fingers placed upon the cutaneous surface of the lids. The rubbings necessary are followed by considerable irritation, which is subdued by means of a cooling lotion, usually of boric acid. Instead of the use of indifferent powders by means of massage, or of boric acid in the same manner, many surgeons have employed the yellow oxide of mercury in the form of a salve. In the experience of the writer in some very stubborn cases of trachoma which have resisted other medical means this has proved an efficient remedy ; but, like other massage treatment of the eye, it is tedious and a good deal of irritation is associated with the method. The yellow-oxide salve simply introduced without severe rubbing, or calomel either in salve or in powder, enjoys a good reputation in the treatment of milder forms of granular lids.

Iodide of silver is said to have an exceedingly beneficial effect in some types of granular conjunctivitis. Sedan [9] recommended that a few drops of a solution of iodide of potassium and glycerin be instilled in the conjunctival sac, followed by the use of a solution of nitrate of silver. Quite recently [10] the most gratifying results from the use of

[1] *Ann. di Ottalm.*, anno xiv., p. 186.

[2] *Arch. d'Ophthalmolog.*, t. 9, 1889.

[3] *Thèse de Paris*, 1889, abst. in *Knapp's Archives.*

[4] *Soc. franç. d'Ophth.*, Apr. 29, 1886.

[5] Sattler (*loc. cit.*) makes the interesting observation that Hairion used chromic acid in the treatment of granulations thirty years before Darrier's time (*Ann. d'Oculistique*, t. 39, p. 213).

[6] *Klin. Monatsbl. f. Augenheilk.*, 1869, p. 430.

[7] *Trans. Amer. Oph. Soc.*, 1870.

[8] *Lancet*, 1871, part ii. p. 604.

[9] *Rec. d'Ophthal.*, 1881.

[10] *Ophthalmic Record*, Sept., 1891.

nascent iodide of silver in the treatment of granular lids have been reported. Berberina and hydrastin have found favor with some surgeons in the treatment of chronic forms of inflammation of the conjunctiva. An aqueous solution of from 2 to 5 per cent. may be employed.[1]

Operative interference of one type or another is contraindicated only in very acute forms, being applicable so long as any granulations appear. The methods which have been employed may be included under abscission or excision of the granulations, with or without portions of the retrotarsal fold; scraping or curetting the granulations with variously devised instruments; crushing the granulations; and destroying the follicles by means of the electro- or thermo-cautery. Many of the surgical procedures have fallen into disrepute on account of the fact that they resulted in cicatrization which was exceedingly disfiguring. The operative treatment of granular lids is by no means a new method, and some of the surgeons in the early portion of the present century warned against the indiscriminate cutting away of the granulations.

As soon as it became evident that the cure of trachoma was hastened by a thorough eradication of its essential feature—the granulations—judicious surgical procedures began to find favor, and, according to Sattler, Pilz[2] deserves the credit of first describing a practical method by excision of the separate granulations with a curved scissors, especially of those which had their seat upon the retrotarsal folds. He operated on only a few granulations at a time, sometimes using a cataract needle to empty the granules of their gelatinous contents.

In 1874, Galezowski[3] methodically practised excision of the retrotarsal folds, afterward to be followed by the ordinary topical treatment. Heisrath[4] employed the operation known by his name, which consisted of the excision of a moderately broad piece of the transition fold of the conjunctiva, the incision to include the subconjunctival tissue and portion of the tarsus. Bleeding having been stopped by ice, a collyrium of carbolic acid (1 per cent.) was employed and any wound granulations snipped away with scissors. Richter[5] advocated excision of the retrotarsal fold to an extent which does not seem justifiable. Schneller[6] practises a more moderate and rational treatment by excising a piece of the retrotarsal fold after the manner of Heisrath, catching up the diseased portion with specially devised forceps, and stretching his incision farther toward the ends of the tarsus, which is not included in the excision. Some operators (Everbusch, Schnabel, Vossius, Richter, and Sattler) introduce sutures after the incisions, believing that these pre-

[1] Consult *Drugs and Medicines of North America*, 1885, vol. i. p. 171.

[2] *Viertel. Jahrsch. f. d. prakt. Heilkunde*, 42, B. (xi. Jahrg.), S. 73.

[3] *Rec. d' Opht.*, 1874, p. 132. [4] *Berl. klin. Wochenschr.*, Nos. 28, 29, 30, 1882.

[5] *Graefe's Archiv of Ophthalomologie*, 1885. [6] *Ibid.*, xxx. 4, S. 131, 1884.

vent the formation of wound granulations; others (Schneller) dispense with their use.

Among the most satisfactory methods of crushing the granulations is the one advocated by Noyes, especially useful in the follicular trachoma. He uses two forceps of special pattern, one in each hand, everts the lids, and holds one end of the tarsus with one forceps, and, applying the other, pulls against the former, thus squeezing and stripping out the granulations. The free bleeding should be wiped away with cotton drenched in a sublimate solution. If there is much reaction, cold compresses may be employed. The subsequent treatment consists in the application of a weak solution of nitrate of silver. For the method of Noyes may be substituted Knapp's treatment, which consists in pressing out the trachomatous substance with a special roller forceps operated on the mangle principle. Dr. Knapp has operated on more than fifty cases with this forceps with most satisfactory results.[1] The author has had a considerable experience with the method advocated by Noyes, and his results have been most satisfactory. Recently he has employed the forceps of Knapp with equally good results. Instead of crushing out the granulations, many surgeons have employed a sharp spoon or similar instrument and curetted away the tissue. According to Sattler, Bardenheuer was the first to employ the sharp spoon for this purpose in 1877, and since his time numerous surgeons have followed this method. Sattler,[2] who has tried crushing of the granulations between the finger-nails or with specially-prepared forceps, objects to the great painfulness of the operation, and thinks that tearing out the follicles with a cataract needle and evacuating their contents with a sharp spoon offers excellent results. He has specially-devised forceps constructed, and operates in the following manner: The follicles are ruptured with a needle and the contents scooped out with a fine spoon, the tissue being put upon the stretch with fixation forceps; all the follicles must be eradicated at one sitting.

The destruction of the granulations by the actual cautery or the galvano-cautery is a method which in selected cases may be followed with satisfaction, but so able an observer as Noyes, who states that he has employed it frequently, prefers crushing the granulations. Samelsohn[3] seems to have been the first to have employed burning of the granulations with a thermo-cautery. Since his time the method has been employed by a great many surgeons.[4]

A special adaptation of the use of electricity in the treatment of

[1] *Archives of Ophthalmology*, Oct., 1891, footnote, p. 583.

[2] *Loc cit.*, p. 32.

[3] *Arch. f. Augenheilk.*, 1873.

[4] Those interested in reference to the literature of this subject will find it on page 19 of Sattler's monograph (*loc cit.*).

granulations is the method published by George Lindsay Johnson,[1] which he has employed with success in cases of chronic and subacute trachoma. The surface of the everted lid is completely scarified with a three-bladed scalpel or *sillonneur*. Bleeding is stopped by means of cotton dipped in a solution of hydronaphthol. In the second stage an electrolyzer which contains two blades is pressed firmly in the grooves which have been made by the scalpel and drawn slowly along the furrows from end to end. About four to six cells of a Stoehrer's carbon-and-zinc battery are necessary. All of the grooves are taken in turn and traversed in this manner very slowly from end to end. The lids are finally washed free from blood and the foamy cream which follows in the track of the electrolyzer, sprinkled with a 5 per cent. solution of cocaine, and dusted with calomel. The eyes are bandaged, and healing is said to take place at the end of a week. During the course of the treatment bathing with boric-acid lotion and the use of hydronaphthol ointment, 1 : 800, is practised. A very old treatment has been rejuvenated by Von Schroeder,[2] which consists in tearing out the granulations by means of a specially-devised wire brush called a trachoma brush (*"brossage"*). Instead of a wire brush, a hard toothbrush has been employed by many, the lids having been previously everted and scarified. Favorable reports of this method of treating granulations may be found in the testimony of Osio, Lloret, and Fernandez.[3] The extensive destruction of the epithelium is the chief objection to this method.

Dr. John E. Weeks,[4] however, recommends partial removal of the granules by scarification and rubbing with a brush, and the introduction of a strong germicide, according to the method pursued in Abadie's clinic. It is also practised by Panas, De Wecker, and others. The fully-exposed fornix of the conjunctiva is scarified with parallel incisions, the exposed surfaces thoroughly rubbed with a toothbrush, which carries a solution of bichloride of mercury 1 : 500. The lids are then freed from clot and bandaged with an antiseptic dressing. After twenty-four hours this is removed and the bichloride-of-mercury treatment continued. The operation is known as *grattage*, and is highly praised by the reporter.

A few words may be said in regard to the general treatment of trachoma, although, as has already been stated, there is no constitutional disorder to which it may be ascribed; its subjects not infrequently are anæmic and scrofulous. It is perfectly true that chronic trachoma appears also in people of apparently perfect health. Should,

[1] *Archives of Ophthalmology*, April and July, 1890, p. 264.
[2] *St. Petersburg. med. Wochenschr.*, 1888, No. 1.
[3] *Archives of Ophthalmology*, Oct., 1891, p. 583.
[4] *New York Medical Journal*, Oct. 24, 1891.

however, the indications for general medication arise, an ordinary tonic regimen is advisable. In quite a number of instances of trachoma the author has found albumin in the urine. Many of the subjects, however, were in a large almshouse hospital, and no doubt were the subjects of various types of endarteritis. None the less, the local measures in these cases were more efficient when done in association with proper diet and the administration of iron in the form of Basham's mixture. Very few, however, would be willing to trust the treatment of trachoma, as Shaffer[1] has done, to the internal administration of potassium iodide without the use of local medication. Residence in a high altitude is advisable.

While many of the drugs which have been described in the previous paragraphs are useful, and may be tried when the ordinary remedies fail, in the opinion of the author the most satisfactory *medicinal treatment* of trachoma includes the use of four drugs: nitrate of silver when there is excessive secretion and in those instances where there is much hypertrophy of the papillary layer of the conjunctiva; strong solutions of bichloride of mercury, in the method already described, in all other stages of trachoma except when there is cicatrization beginning and the tendency to a xerotic condition arises; sulphate of copper, or lapis divinus, valuable at any time except when there is much secretion, but most useful when the surface of the conjunctiva remains rough, but distinct prominences are wanting, and yellowish and white lines begin to intersect each other between the granulating surface; and finally boroglyceride as the granulations are gradually disappearing and the cicatrization becoming more complete, with a tendency to dryness. Success seems to depend upon three points: complete exposure of the affected area and thorough application of the remedy; selection of the topical medication according to the stage of the disease which is present; and the avoidance of unintelligent routine treatment, with scrupulous cleanliness with antiseptic solutions in the interval between the use of local caustic and astringent measures. Of the *operative* measures, crushing the granulations seems to offer the best advantages in the follicular types of the disease, and *grattage* in the diffuse varieties.

Pannus.—If this is mild in character, consisting of only a few vessels in the cornea and slight roughening of the epithelium, it will disappear with the subsidence of the granulations. If it is severe in type and associated with corneal granulations, treatment specially directed to its cure is required. The question how much violent pannus contraindicates the local astringent or caustic which is being applied to the granulations must be decided by observing whether the pannus is aggravated or not by the topical medication.

[1] *Wien. med. Presse*, 1881, S. 759.

Ulceration of the cornea in the presence of any change in the color of the iris or of actual iritis indicates atropine drops. In the absence of iritic complications eserine is the better drug. Inveterate thick and fleshy pannus in former times was treated by inoculating the conjunctiva with blennorrhœic pus, and thus causing a violent acute ophthalmia. As a substitute for this De Wecker introduced jequirity.[1] Any case of stubborn pannus without ulceration may be treated by the production of a violent conjunctivitis with a 3 per cent. infusion of this drug applied twice a day to the everted lids. The application of the remedy is limited, although at one time it was looked upon as a panacea.[2] In the opinion of some authors—for example, Cheatham of Louisville—jequirity powder may be used by putting it directly upon the granulation which it is expected to destroy. He reports excellent results. The operation of peritomy was in former times much practised for the relief of pannus. This consisted of excising a small strip of conjunctiva surrounding the margin of the cornea. Curetting the cornea in cases of inveterate pannus is advised by Gruening,[3] who reports excellent results. His method is to anæsthetize the eye with cocaine, and by means of a gouge-shaped instrument scrape away the whole epithelium of the cornea and its superficial vessels. Each individual vessel is followed well into the conjunctiva. The eye should be frequently bathed with warm saturated boric-acid solution during the operation. A grayish membrane follows this operation. This film disappears in the course of two or three days, and transparent epithelium takes its place. The author in one or two very bad cases of pannus in the Philadelphia Hospital was successful with Dr. Gruening's method. A much milder treatment of pannus, and applicable to the less aggravated cases, is the use of a spray directly against the cornea. The spray may be a weak solution of sulphate of copper or some similar astringent.

Conjunctivitis Æstivalis (Fruehjahr's Catarrh, Spring Catarrh).—This disease is rare, usually seen in children, and is characterized by photophobia, stinging pain, considerable mucous secretion, hypertrophy of the tissues surrounding the limbus of the cornea, and the formation upon the tarsal conjunctiva of flattened granulations containing between them deep furrows. One of its most remarkable characteristics is its return with the early spring, about April, and its subsidence in the fall and winter. The disease is evidently a chronic epithelial overgrowth,

[1] The literature of jequirity is enormous. Those desiring to pursue the subject further will find the most valuable papers and references in *Archives of Ophthalmology*, vol. xiii. p. 206, *et seq.*

[2] Ewsejenko (*Med. Wjestruk*, 1884, No. 13, abst. *Knapp's Archives*) treats pannus without jequirity by instilling several times a day oleum juglandis, and reports cures in six to eight weeks. He uses sulphate of copper in addition.

[3] *Transactions of the American Ophthalmological Society*, 1889.

with simultaneous hypertrophy of the connective tissue, the deep layers of the conjunctiva remaining tolerably normal.

The treatment is efficacious only in so far as the relief of the symptoms is concerned. Locally the use of a mild astringent lotion and calomel are recommended. The destruction of the flattened granulations by means of the actual cautery is proposed by Hansen Grut, and in like manner electrolysis is said to be followed by good results. Dr. L. Webster Fox of this city informs the author that he has had good results with the use of boroglyceride. Sattler reports excellent results by treating vernal conjunctivitis with strong solutions of sublimate in the manner described in connection with granular lids. Internally Fowler's solution should be exhibited, Wecker and Burnett[1] preferring arseniate of sodium in 3-milligram doses three times a day.

Chronic Ophthalmia (Chronic Conjunctivitis.)—There are present under these circumstances hyperæmia, thickening of the papillary layer of the conjunctiva, swelling of the caruncle, soreness of the edges of the lids, and slight muco-purulent discharge. The condition may be a sequel of acute blennorrhœa or arise as an independent disorder. It is common in elderly people.

The *treatment* consists of cleanliness by means of antiseptic lotions, the application of lapis divinus, the alum crystal, or glycerole of tannin (grains 10 to the ounce). Nitrate of silver does not act well in these cases. In fact, the same remarks made in regard to the treatment of hyperæmia for the most part apply to this disease. Hence the puncta lachrymalia should be examined, and, if occluded, opened. Uncorrected ametropia, which may keep up congestion, requires attention.

Lachrymal Ophthalmia is generally a form of chronic conjunctivitis depending upon obstruction of the lachrymal passages. These should be rendered patulous, and the ordinary remedies prescribed which are suitable for chronic ophthalmia.

Lithiasis Conjunctivæ is characterized by a calcareous degeneration of the secretion at the mouths of the Meibomian ducts, commonly seen in elderly people, especially such as are rheumatic. When the lids are everted the small, yellowish-white concretions will be seen, and are gritty to the touch. They act like so many foreign bodies. Each concretion should be removed with the point of a fine needle, the conjunctiva having been previously rendered insensitive with cocaine.

Atropine Ophthalmia occurs at all ages, but is commonest in old people. It sometimes will appear after a few drops of a solution of atropine have been used, but usually not until the drug has been employed for a long time. It presents itself in the form of conjunctivitis characterized by the formation of small granules, not unlike those seen

[1] *Archives of Ophthalmol.*, 1881.

in follicular ophthalmia. Sometimes there is eczema of the surrounding cutaneous surface. The same disease occurs after the prolonged use of eserine, hyoscyamine, duboisine, and homatropine, but much less commonly. It has also been reported from the use of cocaine.

The *treatment* consists in removing the cause of the affection, the use of an astringent such as tannin and glycerin, or the alum crystal. In some instances the author has found a 1 per cent. solution of creolin useful.

Lymphangectiasis of the Conjunctiva consists of the development of small blisters in the conjunctiva, dependent probably upon the interference with the natural lymph-flow and a distension of the lymph-spaces. If there is any spontaneous disappearance, which is frequent, the blisters may be incised.

Xerophthalmos (Atrophy of the Conjunctiva) is the name employed by systematic writers to describe a dry, lustreless, and shrunken appearance of the conjunctiva, which is recognized in two forms—a parenchymatous and an epithelial variety. The parenchymatous type is caused by granular lids, diphtheritic ophthalmia, pemphigus, and essential shrinking of the conjunctiva. It is hence a symptom, and not a disease.

Treatment is practically of no avail, but some comfort may ensue by instilling glycerin and water or by the local use of an emulsion of cod-liver oil. Pilocarpine has been suggested on account of its physiological action, and also vapor baths.

In the epithelial type the conjunctiva assumes a lack-lustre appearance and small cheesy flakes appear, while the ocular surface is thrown into greasy folds. It may occur as an epidemic associated with night blindness, and is seen in people whose nutrition is depraved, especially during prolonged fasts. The treatment demands a nutritious diet, a soothing lotion, dark glasses, and removal from the surroundings which have caused the difficulty.

Amyloid Disease of the Conjunctiva is a rare disorder in which pale, yellowish masses appear chiefly in the palpebral conjunctiva. The diagnosis can be made with certainty only by submitting the tissue to the iodine test. The proper treatment is extirpation.[1]

Pterygium is a fleshy growth consisting of hypertrophy of the conjunctiva and subconjunctival tissue, usually triangular in shape, corresponding to the course of one of the recti muscles, most commonly at the inner side of the eyeball, the fan-shaped expansion arising from the semilunar fold and caruncle, and converging as it approaches the cornea, to the margin of which it is attached.

The *treatment* of this disease consists in *excision*, which is performed

[1] Raehlmann: "Amyloid Degeneration of the Conjunctiva," *Arch. of Ophth.*, vol. x. p. 170.

by seizing the pterygium with a toothed forceps, raising it from the surface of the eye, shaving it from its corneal attachment, then turning it backward and carefully dissecting it from its base, or *transplantation*, which consists in dividing the corneal attachment, turning the pterygium back, and fixing its free margin in an incision in the lower part of the conjunctiva by means of a fine suture. Instead of separating the point of the pterygium with a knife, Prince has suggested that it shall be torn loose with a strabismus hook. This method is very efficacious. The local use of ergot has been recommended, and is said to check the growth of a pterygium.

Pinguecula.—This is a small, yellowish elevation situated in the conjunctiva near the margin of the cornea, usually at the inner side, and also sometimes at the outer side. It looks like a little bunch of fatty tissue, but is fibrous in its nature. It may be removed by picking it up with forceps and excising it.

Ecchymosis of the Conjunctiva occurs when there is an extravasation of blood beneath the conjunctiva scleræ, and occurs under the influence of severe straining efforts; for instance, during a paroxysm of whooping cough. Sometimes it arises without obvious cause. The condition, although often alarming to patients, requires no treatment. The blood will be absorbed.

Chemosis of the Conjunctiva occurs when the connective-tissue layer is distended with serum, and is a symptom of a number of inflammatory diseases of the eye. It also occurs without obvious cause in connection with paralysis of the straight muscles of the eye, as the result of certain medicines (iodide of potash), and sometimes in a recurring form associated with migraine and other nervous disturbances. Ordinarily, the treatment of the disease with which it is associated is all that is necessary. If not, the swollen tissue may be incised.

Emphysema of the Conjunctiva consists in a distension of the connective-tissue spaces with air, and is almost invariably due to an accident. A pressure bandage may be applied.

Syphilis of the Conjunctiva occurs in the form of chancres which develop on the upper and lower cul-de-sac, or even upon the ocular conjunctiva, and sometimes in the form of a special type of conjunctivitis which has been named syphilitic conjunctivitis. The ordinary constitutional measures suited to syphilis are necessary.

Tumors and Cysts of the Conjunctiva.—Translucent cysts, angiomas, lymphangiomas, and dermoid growths have been described; among the benign tumors lipoma, fibroma, osteoma, and papilloma have their habitat upon the conjunctiva. Cysticerci have been occasionally found in this situation. The treatment consists in an excision of the growth with scissors curved upon the flat. The wound may

afterward be united with sutures. Simple cysts will frequently disappear if their anterior wall is cut away.

Epithelioma and Sarcoma are the two malignant growths which are seen in this situation. In a few instances they have been removed with preservation of the eyeball, but in most of the examples the proper treatment is complete excision of the globe.

Lupus and Tubercle of the Conjunctiva.—Lupus occurs as a primary disease or extends to the membrane from the surrounding integument. It appears in the form of red, granulation-like patches placed upon an ulcerated base.

Tubercle of the conjunctiva occurs as a primary and as a secondary affection. The chief symptoms are a somewhat resisting thickening of the lids, dark-red swelling of the conjunctiva, especially of the retrotarsal fold, which is beset with grayish-red nodules resembling the follicles in granular ophthalmia, ulcers with uneven and slightly raised edges, whose floors have a lardaceous appearance or are covered with grayish nodules, slightly sloughing in their apices. The diagnosis depends upon histological and bacteriological examination.

The *treatment* demands destruction of all the diseased tissue. This is best accomplished with a knife, curette, or galvano-cautery. Lunar caustic has also been used with good effect. The subsequent treatment should include the use of a collyrium of bichloride of mercury and dusting upon the surface iodoform or aristol powder. In some of these instances in recent times injections with the fluid of Koch have been employed, a remedy which has also been used in other affections of the eye—for instance, the scrofulous types of keratitis—but at the present writing does not seem to enjoy material advantages.[1]

Pemphigus of the Conjunctiva is a rare affection characterized by the appearance of bullæ associated with pain and lachrymation, and after succeeding attacks degeneration and cicatrization of the conjunctiva.

The disease known as *essential shrinking of the conjunctiva*, although often recorded as an essentially distinct process, in many instances is probably a form of pemphigus. The atrophy of the membrane which occurs under these circumstances is incurable. Palliative measures, by keeping the conjunctiva moist with glycerin and the other treatment recommended in xerophthalmos, may be tried. Rabbit's conjunctiva has been transplanted, but without results.

[1] Consult Burnett, *Arch. of Ophth.*, vol. xix., Nos. 2 and 3, p. 113, and Knapp, *ibid.*, No. 1, p. 78.

AFFECTIONS OF THE CORNEA.

AFFECTIONS of the cornea, comprising about 27 per cent. of the whole number of cases of ocular disease which come for treatment, constitute a group equal in importance to those which have just been described.

Phlyctenular Keratitis and Conjunctivitis (Strumous Keratitis, Pustular Keratitis, Vesicular Keratitis).—This disease is characterized by the formation upon some portion of the cornea of small papules or pustules, often associated with the formation of a similar lesion upon the conjunctiva. The phlyctenules are accompanied by much local congestion, lachrymation, and intense photophobia. The corneal phlyctenules may break down and disappear, or may develop into an *ulcer*. Certain types of the disease have received special names descriptive of the condition. Thus when there is associated ophthalmia the affection is known as *phlyctenular keratitis, with catarrh;* an arrangement of the phlyctenules around the margin of the cornea receives the name *marginal keratitis;* the formation of a single large pustule at the margin of the cornea, surrounded by a yellow area and with a tendency to perforate, is called *pustular keratitis;* and when a phlyctenular ulcer, originally formed at the margin of the cornea, creeps across its surface, followed by a leash of thickly-crowded blood-vessels, the term *fascicular keratitis* describes the affection. The disease is most common in children under the age of puberty and in those of strumous constitution. It follows in the wake of the exanthemata, and is in close connection with inflammatory diseases of the nasal passages, and an irritating rhinitis[1] is a constantly associated affection which in its turn determines an eczema about the nares. Phlyctenular keratitis is under the influence of climate, being more aggravated in warm and moist weather. Micro-organisms have been described. Martin[2] has attempted to demonstrate a relation between astigmatism and keratitis. The disease is exceedingly troublesome, and constant relapses occur. These finally occasion a roughened and vascular condition of the cornea known as *phlyctenular pannus.*

TREATMENT.—*Local.*—The patient's lids, generally spasmodically closed, should be well separated, if necessary with a lid-elevator, in order to apply the remedies. Any discharge may be washed away with boric-acid lotion or a bichloride collyrium (1 : 10,000). Solutions of acetate of lead are not suitable in this or other corneal affections associated with ulceration. Atropine drops sufficient to maintain mydriasis are indicated in nearly every case, but cocaine, except for a temporary purpose to control photophobia, ought not to be

[1] Augagneur, *Receuil d' Ophthalmologie*, Oct., 1888, p. 631.

[2] *Annales d' Oculistique*, tome xc. pp. 14, 176; tome xci. pp. 44, 209.

used. After severe irritation has subsided yellow oxide of mercury (gr. j to 3j), to which ½ grain of atropine is added, aristol ointment, or finely levigated calomel, may be used. The latter must never be employed if the patient is taking at the time any form of iodine, because the iodine is freely eliminated with tears and unites with calomel, forming an intensely irritating iodide of mercury. The photophobia is so intense at times that vigorous measures are necessary to subdue it. The following have been proposed: Douching the eyes with cold water; touching the angles of the eyelids, which are usually ulcerated in a manner analogous to the fissure ani, with a crystal of blue stone, as proposed by Koller;[1] forcibly expanding the eyelids with an ophthalmostat, thus stretching the fissure; dividing the fissure with a delicate knife; and finally attempting to secure direct anæsthesia of the Gasserian ganglion by means of a pledget of cotton moistened with chloroform introduced into the external auditory canal.[2]

The close etiological relation of disease of the nares (probably an infectious rhinitis) to phlyctenular keratitis is deserving of the highest consideration, and the treatment is not complete until the nasal passages have been brought into a healthy condition. For this purpose Augagneur[3] employs a powder composed of equal parts of pulverized camphor, boric acid, and subnitrate of bismuth. This is a most useful treatment, especially if the nares are cleansed with Dobell's solution before the insufflation of the powder. For the same purpose Kolpinski[4] uses a solution of chlorate of potash (15 grains to the ounce), and claims excellent recoveries in scrofulous conjunctivitis without the use of local remedies to the eye. Iodoform in powder or salve, as an intranasal application, is useful. John Dunn,[5] referring to the etiology of phlyctenular eye troubles in connection with diseases of the throat, particularly dwells upon the removal from the naso-pharynx of the adenomatous tissue which he believes to be the prime cause of the trouble. The eyes should be protected with goggles, and the patient encouraged not to bury his head in the bed-clothes. The best possible surroundings must be obtained, with fresh air and wholesome food, coffee, tea, and sweetmeats being forbidden. Cod-liver oil, iron, quinine, often advantageously given with pepsin, arsenic, and small doses of bichloride of mercury, are the most acceptable internal remedies. The urine should be examined in all of these cases, and scrupulous attention to the condition of the alimentary canal is an important factor in the treatment. An excellent regulation treatment is a mild course of mercurial laxatives, especially of calomel, which may be given in doses which are alterative rather than laxative, and in chil-

[1] *Trans. Amer. Ophthalmolog. Soc.*, 1888.

[2] Gutierez-Ponce, *Rec. d'Ophthalmologie*, Feb., 1891.

[3] *Loc. cit.*

[4] *Medical News*, Sept., 1884.

[5] *New York Medical Journal*, Sept. 19, 1891.

dren may be combined with sugar of milk. Martin's contention that astigmatism is a determining factor in the production of keratitis, the disease frequently occurring at about the time school-duties begin, suggests that in a child with this form of ametropia, and at the same time the subject of a scrofulous constitution, the use of glasses should not be delayed. After an attack of keratitis any refractive error should be corrected if the condition of the cornea will permit it. In stubborn forms of recurring vascular ulcer, deep phlyctenular ulceration, and in the fascicular type of this keratitis the use of the actual or galvano-cautery is advisable.

The remaining inflammations of the cornea are divided by systematic writers into *ulcerative* and *non-ulcerative* inflammations.

Ulcers of the Cornea, in addition to those which have been described with the preceding affection, occur when a stage of infiltration in the cornea fails to terminate in absorption, and disintegration of the overlying structures takes place. They are conveniently gathered into several groups:

1. *Simple Ulcer,* often central, appears in the form of a small, superficial gray lesion associated with slight pericorneal injection. It is common in children, and if neglected may form an abscess or go on to a—

2. *Purulent Deep Ulcer,* which consists of an area of yellowish (purulent) infiltration surrounded by hazy cornea, and with a tendency to travel inward and perforate the cornea.

3. *Indolent Ulcer* may appear as a shallow *central lesion* with a slightly turbid base; as an *excavated ulcer,* especially near the margin of the cornea, and quite commonly unattended by congestion, hence its dangerous character; and as a *reparative ulcer,* which occurs when an ordinary ulcer during healing assumes a clear, facet-like appearance and an indolent character.

4. *Infective or Sloughing Ulcers* (purulent keratitis) are characterized by a sharp-margined lesion, the anterior border of which is more elevated and yellow than the rest, and by a tendency to spread and to become complicated with iritis and the formation of pus in the anterior chamber. The most important type of this form is the *acute serpiginous,* or *creeping ulcer* of Saemisch, and the *circular ulcer.* These ulcers depend upon local infection, and often originate in a trifling injury to the cornea, which, through microbic influence (probably a special fungus), spreads into a dangerous inflammation.

As already noted, a small central ulcer may spread and form an abscess. In the earlier stages a nearly central gray area forms, over which the epithelium is unbroken though discolored. This becomes yellow, notches laterally, bulges forward, and finally bursts, leaving a more or less ragged ulcer covered with tenacious pus, the whole process being described under the term *abscess of the cornea.* A combination

of suppuration in the cornea with pus in the anterior chamber is often called *hypopyon-keratitis.* In some instances the abscess terminates without rupture of the upper layers and the formation of an open lesion. Hence abscess of the cornea, according to the stage, may belong to the non-ulcerative or ulcerative affections of the cornea.

In addition to the local symptoms, patients complain of severe brow-pain and the eye is intensely tender; vision is reduced to mere light-perception. In other cases of sloughing ulcer of the cornea or abscess of this membrane the subjective symptoms of inflammation are almost absent.

Abscess of the cornea results from inoculation of the affected area with the pathogenic micro-organisms which are the cause of suppuration. Violent forms of suppurative keratitis occur during the convalescing stage of small-pox, and abscess of the cornea is occasionally seen with scarlet fever, measles, typhoid and typhus fever.

5. *Ulcus Rodens* is the name applied by Mooren to a form of creeping ulcer which begins at the upper edge of the cornea as a superficial lesion, separated from the healthy portion by a gray opaque rim which is undermined. Although cicatrization may apparently begin, the disease quickly relapses and progresses until the whole cornea is traversed and sight is destroyed.

6. *Circular Ulcer* occurs in the form of a deep groove of the corneal margin, unaccompanied by much infiltration. It gradually progresses until it entirely girdles the cornea and cuts off its nutrition. Subjective symptoms of inflammation are not prominent, but perforation and prolapse of the iris are common. A marginal phlyctenular keratitis by coalescence with a number of small foci may produce a ring ulcer. Circular ulcer also occurs in debilitated subjects, and may be seen in connection with purulent ophthalmia.

7. *Dendriform Ulcers* are a form of keratitis depending upon a special micro-organism, and appear in branch-like ramifications having a superficial situation. The associated symptoms may be those of an acute inflammation of the cornea, or the disease may assume a torpid and subacute character. The actual cause is not positively known. According to Fuchs, the disease may arise from febrile herpes of the cornea. Malaria originates a keratitis in which the lesion consists in a peculiar serpiginous ulcer with lateral offshoots, like the veins in a leaf. This has been particularly described by Kipp.[1]

8. *Exhaustion Ulcers* arise when an ulceration of special microbic type occupies the cornea, usually in the centre, or appears in the form of a ring abscess around its circumference. The tissue of the cornea is speedily converted into a slough; in other cases slow atrophy of the

[1] *Transactions of the American Ophthalmological Society,* 1890.

membranes takes place. This condition is sometimes described under the term *kerato-malacia.*

Local Treatment of Ulcers of the Cornea.—The *mild forms* of ulcers of the cornea require practically the treatment which has been described in connection with Phlyctenular Keratitis. Usually, atropine, a lotion of boric acid, and dark glasses will suffice. Blisters and setons are seldom required; an occasional leech in a sthenic case may be needed. It is very important to remember that cocaine, although it will relieve photophobia, is positively harmful as a continuous application in corneal ulceration. If conjunctivitis accompanies the ulcer, the collyria already described are useful.

After the acute symptoms have subsided local stimulation is required. This is best accomplished with Pagenstecher's ointment, which consists of 1 grain of yellow oxide of mercury to the drachm of vaseline, to which $\frac{1}{4}$ grain of the sulphate of atropine may be added. Later the atropine should be omitted from the salve and the mercury compound alone employed. Powdered calomel answers a like purpose, provided the caution in regard to its employment if the patient is under the influence of an iodide is exercised. Iodoform or aristol in powder or salve may be used.

A sluggish ulcer or one that is in the healing stage may be stimulated by touching it with a probe dipped in laudanum or a small pledget of cotton moistened with a weak solution of nitrate of silver. Eserine, instead of atropine, is a useful drug in small sluggish ulcers.

Deep, sloughing, and *creeping* ulcers require much more active measures than those which have just been briefly described.

The first question to be decided is whether the patient shall be ordered atropine or eserine drops. Formerly atropine was the drug universally employed, because it lessened the liability to iritis, mitigated the severity of the inflammation, and contracted the vessels of the ciliary region. Eserine in many instances is the better drug, because it has the power of stopping the migration of white blood-corpuscles, promoting absorption through dilatation of the ciliary vessels, and acting locally upon the ulceration, limiting the sloughing process. If the tension is raised, it lowers this. Its one contraindication in the treatment of sloughing ulcers of the cornea is the presence of iritis. The drug should be used during the day-time in the strength of from $\frac{1}{6}$ to 1 grain to the ounce, instilling a couple of drops at a time every three or four hours. At night atropine drops may be employed. Pilocarpine in twice the strength may be substituted for eserine.

Pain is relieved and the process of repair encouraged by the frequent application of hot compresses in the manner already described. During all this time the cul-de-sac should be irrigated frequently with

antiseptic collyria, a saturated solution of boric acid, or bichloride of mercury, 1 : 10,000.

Instead of these solutions others have found favor, many of which have been mentioned in connection with conjunctival diseases.

In spite of the assertions of Stilling and others who have followed him, in the judgment of the author pyoktanin has no place in the treatment of ulcers of the cornea.

Creolin has been used with good effect; for instance, Grossman[1] employs a 1 per cent. solution with excellent results in ulcerated keratitis, and especially in the dendritic form of corneal ulcer, and Galezowski[2] recommends this drug in all corneal complications depending upon micro-organisms. The same author, in connection with Petit, has produced by decomposition of an aniline dye benzo-phenoneid, soluble in 100 parts of water, which it is claimed acts like pyoktanin, but its powers so far seem to have received no further confirmation.[3] Purulent keratitis, in addition to the local application of a sublimate collyrium, has been treated by Secondi[4] with subconjunctival injections of bichloride of mercury in the strength of 1 : 2000, 1 : 5000, and 1 : 10,000. The good effects are said to have been apparent within twenty-four hours. Iodoform very justly holds a high place in the treatment of corneal ulceration of a sloughing type. It may be used in salve or in powder, and will be referred to again in connection with other treatments. The recommendation for the use of this drug in ulcerative processes of the cornea, especially in the serpentic forms and in superficial and deep injuries of the cornea, is quite universal. Vossius[5] and Deutschmann[6] are particularly strong in their recommendations.[7] In recent times aristol has been substituted for iodoform.[8] The following formula has been found useful:

Aristol,		gr. xv;
Vaselini vel lanolini,	*āā.*	gr. lxxv.

The further consideration of the treatment of grave ulcers of the cornea and their complications may be best considered by taking up the matter under several headings:

[1] *Wien. med. Presse*, 1888, Nos. 31 and 32.

[2] *Rec. d'Ophthal.*, 1888, No. 8, p. 534.

[3] *Lancet*, Jan. 10, 1891; *Therapeutic Gazette*, March, 1891.

[4] *Boll. d'Ocul.*, vol. xi., 1889. [5] *Arch. f. Ophthalmologie*, xxix. 1, 1880.

[6] *Ibid.*, xxviii. 1, 1882.

[7] The iodoform treatment, however, was not without failures, and the statistics of these observers, as well as those of Alker, show between 6 and 7 per cent. of shrunken eyeballs, the corneas of which had been the subjects of purulent ulcers. Linear cauterization of the lower fornix of the conjunctiva has been recommended by Schies and also by Fisch (*Inaug. Dissert.*, Basel, 1884), and very good results are reported.

[8] *Rev. gén. ét de la Clin. et de Thérap.*, Sept. 18, 1890.

(1) *Impending Perforation.*—When perforation of the cornea seems likely to occur, and in the absence of a purulent conjunctival secretion, an antiseptic *compressing bandage* may be applied. This should be removed each day or a number of times each day, and the local applications introduced.

If the perforation is imminent, evident by the bulging forward of the floor of the ulcer, and the intraocular tension is raised, *paracentesis of the cornea* should be performed. This is done as follows: The cornea is punctured near its lower margin or directly through the floor of the ulcer with a paracentesis needle, constructed with a shoulder to prevent undue depth of entrance, the insertion being an angle of forty-five degrees with the point of contact. In place of this a broad needle held flatwise may be employed, the point being kept well forward, so as to avoid wounding the lens. By rotating the needle slightly on its long axis the lips of the opening are separated, and the contents of the aqueous chamber more readily escape. The act of withdrawing the needle must be slowly performed, lest a sudden gush of aqueous cause prolapse of the iris. If it is desired to reopen the wound on a subsequent day, the probe end of the instrument should be used. After the performance of the operation eserine is instilled if the ulcer has a peripheral situation; atropine, if it is central. The bandage is reapplied and the patient placed in bed. Intense pain may often be thus speedily relieved and healing rapidly result. In place of paracentesis perforation with the actual cautery may be practised, as will presently be described.

(2) *The Spread of Local Infection.*—If in spite of such treatment the corneal ulcer continues to spread, the process must be stopped by one of several means—scraping with a curette, the direct application of a suitable chemical which combines the properties of a germicide and a caustic, and the actual cautery.

The ulcer may be cautiously curetted with a sharp spoon and all the sloughing material removed, the edges pencilled with a sublimate solution 1:2000, and the same drug used freely as a collyrium, 1:10,000; or Berry's[1] treatment may be employed, which consists in scraping the margins of the ulcer until it is thoroughly broken down, then cauterizing the whole surface with a 2 per cent. solution of nitrate of silver, and finally smearing into the eye every two or three hours an ointment composed of 1 part of finely-powdered iodoform to 9 parts of vaseline.

The treatment of scraping the corneal ulcer in this manner, followed by the applications recommended, is not only a suitable treatment for grave types, but may often be employed with great satisfaction in the simpler varieties of ulcers.

[1] *Ophthalmic Review*, 1884, p. 35.

In addition to nitrate of silver, carbolic acid is a useful chemical to stop the spread of local infection. Either of the drugs, the former in the strength of 10–20 grains to the ounce, and the latter in a liquid, may be applied directly to the point of ulceration by means of a delicate probe upon the end of which a bit of cotton is twisted to a fine point. Care must be taken that the drug reaches only the ulcerated spot.

The actual cautery in the treatment of ulcers of the cornea was introduced in 1873 by Martinache of San Francisco,[1] and about the same time Samelsohn[2] advocated the galvano-cautery in affections of the lachrymal apparatus, conjunctiva, and ciliary border—a method which before that time, in the hands of Middeldorpf, Bruns, Althaus, Groh, and other surgeons, had proved its value in a variety of types of special practice. At first the method did not receive general approval; later, actual cauterization of the cornea received the earnest recommendation of Gayet,[3] Grandmont,[4] Martin,[5] and Fuchs.[6] In spite of these recommendations, the method did not appeal to the profession generally, and sloughing ulcerations of the cornea were treated with other methods. The discovery of the mycotic nature of many of the destructive processes of corneal inflammation led Sattler[7] to urge the galvano-cautery as a most powerful method of dealing with these types of corneal disease. A year later Nieden,[8] after reviewing the history of other methods of treating serpent and rodent ulcers, published his observations with the use of the actual cautery, and reported the most happy results. The following table, which he has compiled partly from his own statistics and partly from the inaugural thesis of Fisch, shows the results:

Result.	Incision (113 cases).	Iodoform (63 cases).	Linear Cauterization (68 cases).	Galvano-cautery (100 cases).
Phthisis . . .	9.7 per cent. (4 per cent.)	6.3 per cent.	1.4 per cent.	0 per cent.
Leucoma adh.	26.5 per cent. (22 per cent.)	93.6 per cent.	28 per cent.	3 per cent. leuc. adh.
Macula . . .	61 per cent.		66.2 per cent.	9 per cent. leucoma. 88 per cent.
Unknown . .	3.5 per cent. (4 per cent.)	. . . . .	4.4 per cent.	
Duration of treatment.	. . . . .	20 days.	30.7 days.	13.5 days.

Other results, published by Schweigger, Knapp, and Gruening,

[1] *Pacific Medical and Surgical Journal*, 1873.
[2] *Arch. of Ophthalmology and Otology*, vol. iii. pt. 2, p. 124.
[3] *Gaz. hebd.* 6, 1877. [4] *La France méd.*, vol. xxviii. p. 278.
[5] *Journ. de Méd. de Bordeaux*, vol. x., 1880, p. 182.
[6] *Brit. Med. Journ.*, 1880, vol. ii. p. 780.
[7] *Trans. of the Fifteenth Annual Meeting of the Heidelberg Ophth. Soc.*, 1883.
[8] *Archives of Ophthalmology*, vol. xiv. p. 33.

placed the method upon so secure a basis that the actual cautery has become a wellnigh indispensable instrument in the management of certain types of ulcerative keratitis, and is a surgical procedure constantly employed by every practising ophthalmic surgeon.

The actual cautery may be either a small Paquelin or galvano-cautery, and very satisfactory instruments have been devised for the purpose of the operation, one of the most useful being the apparatus of Professor Sattler. Although Nieden condemns anything else except an instrument of precision of this character, very excellent results may be obtained by means of a knitting-needle or platinum probe heated red hot in the flame of a Bunsen burner. Some surgeons—as for instance, Everbusch[1]—prefer the thermo-cautery to the galvano-cautery.

According to the situation of the ulcer and according to the condition of the iris the eye is either atropinized or eserinized, a few drops of cocaine are instilled, and the glowing point of the instrument is transferred to the point of disease, and all of the sloughing material gently but thoroughly cauterized. Usually one application is sufficient, but it is well known this may be repeated on the third or fourth day, indeed several times repeated, according to the indications, provided the original destruction of the tissue has not been sufficient. A most important suggestion by Nieden[2] is in the use of fluorescin-coloring as an aid to this operation. Previous to its introduction there was a lack of the exact means of determining how extensive should be the application of the cauterization. Fluorescin, which colors green any portion of the cornea deprived of its epithelium, dropped into an eye will exactly differentiate between the sound and diseased area and indicate to a nicety how much tissue should be destroyed. The ordinary 2 per cent. solution, to which 3.5 per cent. of carbonate of soda has been added, may be utilized. In some observations by the author[3] the value of this recommendation was confirmed.

It has been urged against the employment of the actual cautery that a much more dense scar or leucoma is likely to form than when the ulcer is treated in the ordinary way. The following quotation from Fuchs[4] is apropos: "On the cauterized spot an opacity always remains, but as one cauterizes only that spot which without this would meet with the ulcerous disintegration, the final opacification on account of this will not be greater than it would have been in the first place." The author has had the most happy results in the treatment of corneal ulcers with the actual cautery.[5] In any case in which it is desired

[1] *Klin. Monatsbl. f. Augenheilk.*, 1886.
[2] *Centralbl. f. prakt. Augenheilk.*, May, 1891.
[3] *Medical News*, Aug. 15, 1891.
[4] *Lehrbuch der Augenheilkunde.*
[5] *Trans. of Phila. County Med. Soc.*, 1890.

to secure, in addition to the destruction of the ulcerated process, the advantage of evacuating the anterior chamber, this may be opened with the cautery instead of using the paracentesis needle. Indeed, Nieden recommends that this shall be done.

It may be said in regard to the actual cautery that it is indicated in all sloughing ulcers which fail to show improvement after milder measures have been tried, and in torpid or relapsing ulcers without much reaction where a decided stimulant is needed. It is demanded in certain types of infecting ulcers of serpiginous character, and also in annular ulcers and furrow keratitis where the local infection is less marked. In rodent ulcer it is one of the few means that are at all efficacious. The actual cautery should not be used simply because there is a corneal ulcer, but to produce the effects which have been described. In very extensive lesions it may be sometimes unwise to use it, and in hypopyon-keratitis with much pus in the cornea the section of Saemisch presently to be described seems better. The actual cautery should not be applied to an ulcer which has already perforated and to the margins of which the iris has become adherent.

Abscess or hypopyon requires evacuation of the pus. If the abscess is unbroken, its anterior wall may be incised with a delicate knife, and the subsequent treatment conducted on the principles laid down for sloughing ulcers.

If the abscess has burst and is complicated with hypopyon, the actual cautery is applicable, or if the pus is very tenacious the section of Saemisch. This is done as follows: A cataract knife is entered in one side of the cornea with its cutting edge upward, carried across the anterior chamber to the other side of the ulcer, and the section made directly through the diseased area, evacuating thus at the same time the collection of pus in the layers of the cornea and at the bottom of the anterior chamber. If the hypopyon is tenacious, this may be removed by inserting a delicate pair of forceps through the incision and seizing the slough, or this may be washed away with a specially-devised syringe, the most suitable being the one devised by Lippincott of Pittsburg. As Gruening has said, in these cases a combination of the two methods appears rational; for the actual cautery destroys the septic material of the cornea, and the Saemisch section removes the septic material from the anterior chamber. One drawback to the Saemisch section is the danger of prolapse of the iris, especially in children.

(3) *Perforation.*—If perforation has occurred, the vigorous use of atropine or eserine, according to the situation, aided by gentle efforts at reposition with a probe, followed by a compressing bandage and rest in the recumbent posture, should be tried. In the event of failure, or in any event if the prolapse is a large one, the iris should be

drawn forward through the aperture and excised close to the cornea, provided not more than two or three days have elapsed since the accident. After excision the aperture may be covered with a conjunctival flap after the manner of Gama Pinto.

In any case of corneal ulceration the presence of a foreign body should always be excluded. Sometimes a very minute one is the nucleus of an ulcerated area. The lachrymal passages should be explored and if strictured rendered patent, the lachrymal canal at the same time being irrigated with an antiseptic lotion. The naso-pharynx needs examination and the correction of any diseased condition. The teeth should always be inspected, and if faulty the case turned over to a competent dentist. There is sufficient evidence on record to show that carious teeth and ulceration of the cornea are often associated conditions.[1]

Constitutional Treatment of Corneal Ulcers.—Proper attention to hygiene, diet, and judicious internal medication is of paramount importance. The diet must be nutritious and easily digested; tea, coffee, candies, and pastry are to be forbidden. If struma is present, cod-liver oil, lactophosphate of lime, iodide of iron, and syrup of hydriodic acid are indicated. Anæmia is best treated with the various preparations of iron. Any suspicion of malaria requires the use of quinine and arsenic, while the syphilitic taint, which may be present without being the direct cause of the ulcer, calls for the iodides and mercury. As gout has been shown to be the cause of some corneal ulcers, this, as well as the rheumatic dyscrasia, must be searched for and if present suitably treated. A very strict inquiry into the condition of the alimentary canal should never be forgotten. Calomel is a useful laxative, and in older patients the salines and saline waters are often necessary.

A very important element in the successful management of cases of sloughing ulcers, especially in subjects of depressed nutrition, is the maintenance of proper circulation. This seems best secured by the exhibition of brandy or whiskey in milk and of strychnine or digitalis as vaso-motor or cardiac tonics. Severe pain may be alleviated by opium or morphine, the drug always having a distinct influence for good upon the ulceration. Antipyrine is also useful for this purpose.

Results of Corneal Ulceration, and their Treatment.—Every corneal ulcer is followed by a scar. If the opacity is slight, it is called a *nebula* or *macula;* if dense, a *leucoma,* to which the iris may or may not be attached. After perforation of an ulcer in which the iris remains entangled in the aperture an *anterior synechia* results. An eye

[1] Any one interested in the literature of the connection between diseases of the teeth and diseases of the eye should consult the valuable paper upon this subject by Dr. Albert Brubaker in the *American System of Dentistry.*

thus affected may become quiet, or it may be a continual source of annoyance and subject the patient to the dangers of sympathetic irritation. The distension of a cicatrix to the inner surface of which the iris is attached constitutes a *corneal staphyloma*, which may be *total* or *partial*. In addition to these defects, the result of corneal ulceration, there may be *kerectasia*, or a bulging forward of the deeper layers of the cornea after loss of the superficial lamina. This differs from the staphyloma because there has been no perforation and the iris is not involved in the process. If all of the layers of the cornea are destroyed down to the posterior elastic lamina, and this protrudes through the opening, the condition is known as *keratocele*. Finally, an orifice may remain after a wound or ulcer of the cornea which fails to close, which constitutes a *fistula of the cornea*.

Treatment of the Results of Corneal Ulceration.—Faint opacities will sometimes clear up in a surprising manner, especially in children, particularly under the influence of stimulating salves such as Pagenstecher's ointment. Wolfring[1] at one time recommended an ointment composed of metallic mercury incorporated with vaseline in the treatment of processes of infiltration of the cornea—a method, however, which has not found favor with Nieden[2] after experimenting with it for four months.

(*a*) *Massage of the Cornea.*—The use of yellow oxide of mercury for the purpose of clearing up opacities of the cornea has just been mentioned. Resting upon Pagenstecher's recommendation, this stimulating ointment has been rubbed in with massage movements. Since that time the method has been used with gratifying success, some surgeons having demonstrated that the massage itself was the efficient agent by the omission of any medicament and the employment of a simple ointment as a lubricatiug substance. Dalamix[3] found the method useful in chronic diseases of the cornea in young people if used in combination with the yellow-oxide ointment and general treatment. Dantziger[4] reports success with the yellow oxide. Pfalz,[5] who has gone over the whole matter in a most thorough manner, employs a salve the nature of which will vary with the disease, and uses the method not only in opacities of the cornea, but in affections of the anterior segment of the eye, iritis being excluded, with satisfactory results; and the author[6] has reported a series of cases in which a careful testing of the vision before and after treatment showed distinct gain. Yellow oxide of mercury was employed.[7] For the purpose

[1] *Monatsbl. klin. Augenheilk.*, p. 433, 1880.

[2] *Centralblatt f. prakt. Augenheilkunde*, Feb., 1881.

[3] *Arch. d' Ophth.*, Sept., Oct., 1881.

[4] *Arch. f. Ophthal.*, vol. xxxi. 3, p. 187.

[5] *Deutsch. med. Wochenschr.*, 1889, No. 2.

[6] *University Medical Magazine*, Sept., 1889.

[7] The whole subject of massage has recently been reviewed in a most exhaustive

of massage Heisrath[1] prefers an ointment composed of iodide of potash 1.0, bicarbonate of soda 0.5, and vaseline 10.0. With this salve he claims to have had surprisingly good results in the treatment of old opacities of the cornea, and not only those due to interstitial keratitis. In stubborn cases he removes the upper layers of the cornea and applies the ointment. The massage movements should be made through the closed lids, over the cornea, in a circular and radial manner, the séance lasting from one to three minutes after the introduction of a small piece of the ointment. Some irritation accompanies the method, which may be allayed by the occasional use of a boric-acid lotion.

(*b*) *Galvanism of Corneal Opacities.*—The electrolytic treatment of permanent opacities of the cornea has a number of advocates. Adler,[2] after atropinizing and cocainizing the eye, uses Seeger's electrodes attached to a Siemens-Halski battery (1.1–0.15 milliampère), and applies the positive pole to the conjunctiva bulbi, while the opacity is touched lightly with the negative pole for about fifteen seconds. After eight to ten days improvement in vision was noted, especially when calomel was used at the same time. The method is contraindicated in total leucomata and in inflammatory conditions of the eye. Hubert[3] recommends bipolar electrolysis in cicatricial and sclerotic corneal opacities. Recently, L. A. W. Alleman of Brooklyn[4] has called attention anew to this subject. A suitably prepared electrode is connected with a battery, the cathode being applied directly to the anæsthetized surface of the cornea and the anode to the soft tissues of the cheek. Usually a current of from one to one and a quarter milliampères gives the best results. Great care is taken not to produce too much reaction.

As a cosmetic operation tattooing of leucomata may be practised, and the colors made to conform to those of the iris, as suggested by De Wecker, Levis, and others.

(*c*) *Surgical Treatment.*—Dense leucomas are uninfluenced by massage and electricity. If a clear cornea remains, vision may be improved by an iridectomy. In recent times some attempts to increase sight in cases of central leucomata have been made by transplanting rabbit's

manner, both from the historical and practical standpoint, by Costomiris (*Arch. d'Ophth.*, tome x. 1890, p. 37), to which paper any one interested in the literature of the subject is referred.

[1] *Berlin. klin. Wochenschr.*, No. 2, 1884.

[2] *Wien. med. Wochenschr.*, No. 18, 1885. According to Adler, Crussel (*Ueber den Galvanismus als chemisches Heilmittel gengen örtliche Krankheiten*, Petersburg, 1841) was the first to employ electrolysis in the treatment of corneal opacities. This method was also employed by Mackenzie (*Traité des Maladies des Yeux.*, 1857).

[3] *Soc. franç. d'Ophth.*, April 28, 1886.

[4] *Brooklyn Medical Journal*, Nov. and Dec., 1890. See also *Medical News*, 1891.

cornea. Although Von Hippel,[1] the originator of the method, reports some encouraging results, the operation is not likely to find general favor.

The treatment of staphyloma, in the first place, is preventive—viz. a compressing bandage and the use of eserine, or, under other circumstances, atropine. If the bulging continues, paracentesis of the anterior chamber or an iridectomy opposite to the clearest part of the pupil may be performed. If the disease has become extensive and the eye sightless, especially in the presence of threatened sympathetic inflammation, enucleation or evisceration is indicated. Total staphylomata are also treated by abscission and resection of the optic nerve.[2]

Infantile Ulceration of the Cornea, with Xerosis of the Conjunctiva.—This disease is characterized by a dryness of the conjunctiva and destructive ulceration of the cornea, and usually appears in badly-nourished infants under one year. The peculiarity of the affection is a lack-lustre appearance of the conjunctiva, in which cheesy flakes form, while the cornea passes into ulceration, followed by hypopyon and iritis. The eyeball is generally destroyed.

The treatment requires the usual measures indicated for corneal ulceration and general supporting measures. Kollock[3] of South Carolina describes a somewhat analogous though less severe affection which he has seen among negro children, and in which treatment with yellow-oxide salve, boric-acid solution, and atropine drops, with suitable constitutional measures, proved beneficial.

Neuroparalytic Keratitis occurs when the cornea has become anæsthetic by the removal of the influence of the fifth pair of nerves. Any cause which severs the connection of the trigeminus with the cornea may originate the affection—*e. g.* disease of the Gasserian ganglion, disease of the nuclei of the nerve, periostitis of the orbit, syphilitic deposits, and fracture of the skull.

TREATMENT is not very effectual, but the affected eye should be excluded from the influence of external irritants either by a carefully applied antiseptic bandage or by stitching the lids together. Experimental evidence indicates the propriety of preventing evaporation by keeping the eye in a moist atmosphere.[4]

Herpes Corneæ.—This disease, which should not be confounded with phlyctenular keratitis, may arise with the same affections which cause herpes of the lips and nose. It is seen in acute and subacute

[1] *Archiv f. Ophthalmologie*, 1, S. 108, 1888.

[2] For the details of the various surgical procedures suitable in cases of partial and complete staphyloma, the reader is referred to De Wecker's *Ocular Therapeutics*, p. 150.

[3] *Ophthalmic Review*, Sept., 1890; *Therap. Gazette*, Jan., 1892.

[4] Consult Hippel, *Archiv f. Ophthalmologie*, Bd. xxxv. 2, p. 217.

affections of the posterior nares and pharynx, and also in affections of the respiratory apparatus generally. The disease begins with a series of transparent vesicles on the cornea, which speedily rupture and leave a patch deprived of its epithelium, which is anæsthetic. Fresh vesicles constantly reappear. Iritis and hypopyon may occur. Pain, photophobia, and lachrymation are present.

The general condition requires attention. Usually full doses of quinine are indicated. Locally, in the stage of irritation, atropine, with the cautious use of cocaine and warm compresses, are needed. Later, calomel may be dusted into the eye. After the formation of the ulcer a light touch of the actual cautery is the best remedy, and if iritis is absent eserine may be used. If iritis ensues, the usual remedies for this condition are required—atropine, leeches to the temple, and warm compresses.

Keratitis Bullosa is a symptom of disease rather than a separate disease, and appears in the form of large or small blebs upon the cornea of an eye the subject of iridocyclitis, interstitial keratitis, or glaucoma. Sometimes moderately large vesicles form upon a cornea otherwise normal, and in one case malaria was believed to be a factor.[1] The treatment consists of puncture of the vesicles. Iridectomy or enucleation may be required in bad cases; quinine is indicated if malaria is suspected.

Among the most important *non-ulcerative* forms of corneal disease may be included—

1. **Vascular Keratitis.**—A superficial vascularity of the cornea is seen in pannus caused by granular lids, and in phlyctenular pannus the result of many relapses of interstitial keratitis. A true form of this disease is characterized by the formation of two opposite vascular areas at the upper and lower margins of the cornea, which approach each other until the vascularization is complete. The disease is encountered in young adults and unhealthy children.

All local irritants are contraindicated. Atropine, cocaine, and warm fomentations are useful in the acute stages; later, yellow oxide and calomel may be tried. Iron and bichloride of mercury may be exhibited. Mr. Carter[2] has suggested the application of the galvano-cautery to the convex side of the vascular crescent.

2. **Interstitial Keratitis (Syphilitic, Inherited, Specific, Parenchymatous, Strumous, and Diffuse Keratitis).**—The majority of cases of interstitial keratitis are due to inherited syphilis; in rare instances acquired syphilis produces a type of keratitis quite indistinguishable from the ordinary form of the disease. This affection has also been attributed to rachitis, scrofula, malaria, rheumatism, and

[1] Tangeman, *Archives of Ophthalmology*, vol. xvii. p. 92.

[2] *Ophthalmic Surgery*, p. 149.

depressed nutrition. It is most frequent between the ages of five and fifteen.

The symptoms are at first slight ciliary injection and faint cloudiness of the cornea. The spots of haze are interstitial deposits. Gradually the disease progresses, and in two or three weeks the whole cornea is invested with a diffuse haziness, almost completely hiding the iris. The steamy surface is often compared to ground glass. The ciliary injection increases. Blood-vessels form in the superficial layers of the cornea and produce a dull-red color, the "salmon patch of Hutchinson." Sometimes the entire cornea becomes cherry-red, like the type described under Vascular Keratitis. Iritis, cyclitis, and retinitis are often associated disorders, and secondary glaucoma and shrinking of the eyeball may occur.

In the course of time, varying with the treatment, the eye begins to clear. Perfect recovery of transparency must be rare, and years after an attack of interstitial keratitis the old vessel-channels in the cornea may be detected. Sometimes a dense central opacity remains. The subjects of interstitial keratitis usually possess other characteristics denoting the syphilitic taint—scars at the angles of the mouth, nodes on the tibia, tumefied lymphatic glands, and vertically notched central incisor teeth (Hutchinson's teeth).

From six to eighteen months are required for the development of the various stages of the disease. The second eye is almost certain to be attacked.

Treatment.—All irritating applications are harmful. Atropine to maintain mydriasis and prevent iritis should be systematically employed. Hot fomentations and leeches to the temple are suitable in high grades of inflammation. The eyes should be protected by goggles. The best constitutional remedy is a long-continued course of mercury. The most satisfactory method of administration is by inunction, 1 drachm of blue ointment (some surgeons prefer the oleate of mercury) being rubbed into the skin once or twice a day. Whenever slight tenderness of the gums indicates the full physiological action of the remedy, the inunctions should be suspended and the patient put upon a course of iodide of potash. During the inunction of the mercury salve cod-liver oil may be exhibited. Later, a long-continued course of bichloride of mercury is a valuable remedy, and, as many patients are anæmic, this is usually combined with the tincture of the chloride of iron.

Suspicion of malaria calls for quinine and arsenic, and in any event these are valuable adjuvants to the treatment. If rheumatism or rachitis is present, the salicylates and phosphates are worthy of trial. After all irritation has subsided, clearing of the remaining opacity is facilitated by the means described on page 974. Iridectomy may be neces-

sary if the tension rises or for the purpose of improving vision if a central corneal opacity remains. All the precautions in regard to diet, exercise, and healthful surroundings which have been urged in the treatment of corneal ulcer apply with equal force in the management of this disease. Abadie[1] and other surgeons have recommended that the mercury be given in the form of hypodermic injections. An observation of the plan of treatment has not induced the author to abandon the methods which have been described.[2]

3. **Keratitis Punctata.**—This disease occurs as a secondary affection in association with affections of the iris, choroid, and vitreous. It is characterized by a precipitate of opaque dots, generally arranged in a triangular manner, upon the posterior elastic lamina of the cornea, and is sometimes designated *Descemetitis*. The name "keratitis punctata" is also given to an inflammatory affection of the cornea in which isolated white spots appear in this membrane surrounded by cloudy areas. Iritis and diffuse corneal haze develop later. The disease is seen in children before puberty, and is probably syphilitic.

Generally any type of keratitis punctata requires iodide of potash and bichloride of mercury. A continued atropine mydriasis should be maintained unless the tension rises; later iridectomy may be required.

4. **Keratitis Superficialis Punctata.**—This disease, which is probably analogous to herpes-like corneal inflammations, appears under several forms and has been described under a variety of names —*keratitis subepithelialis centralis, keratitis maculosa*. The forms are very different types of the same disorder or closely analogous conditions.

It begins with the symptoms of a sharp conjunctivitis, while at the same time there is catarrhal disease of the respiratory tract. In two or three days punctiform or linear spots appear immediately beneath the epithelium, the overlying conjunctiva being slightly hazy. According to some observers, the foci are more commonly seen in the periphery; according to others, in the centre of the cornea. The foci are often joined by radiating gray lines which have been compared to the fissures in ice. The duration of the disease may be tedious or cure occur in one or two weeks.

The *treatment* should be directed to the condition of the nasopharynx, and its mucous membrane brought into a healthy condition. Locally, during the stage of irritation atropine is useful, and later the yellow-oxide salve. Full doses of quinine are indicated, and the use

[1] *Soc. franç. d'Ophth.*, 1887.

[2] Chas. J. Lundy (*Hypodermic Medication in Diseases of the Eye*, Detroit, 1890), who is strong in his recommendations of the hypodermic use of mercury in syphilitic diseases of the eye, finds the method less successful in inherited specific keratitis than in most other cases.

of the constant current along the region of the supraorbital distribution has been recommended.

Unusual forms of keratitis are—

(1) **Keratitis Profunda**, characterized by the formation of a gray opacity in the centre of the cornea covered by superficial and stippled corneal layers. The corneal opacity is composed of a number of individual points or gray interlacing stripes. The deposit may entirely absorb or leave a permanent opacity. Sometimes the cause is not discovered; in other examples cold, rheumatism, and malaria probably originate the disorder. Atropine, and later yellow-oxide-of-mercury salve, may be employed. Constitutional treatment is directed according to the probable cause.

(2) **Keratitis Marginalis**, a form of disease not to be confounded with the gathering of phlyctenules at the margin of the cornea. It occurs in elderly people, and consists of a yellowish-gray zone of opacity immediately joining the sclera, which pushes into the clear cornea and occupies about one-half the circumference. The vessels of the limbus cover the opacity and gradually the inflammation subsides. It resembles the same corneal opacity which occurs with some of the types of scleritis. The usual treatment of chronic keratitis is appropriate.

(3) **Ribbon-like Keratitis** is a name applied to the formation of a tranverse calcareous film on the cornea, especially in elderly people. The constitutional causes of this disorder, which is almost always symmetrical and usually occurs in men, are gout and excess of uric acid, and it is sometimes accompanied with iritis, glaucoma, and hæmorrhagic retinitis.

In another variety of the disease a roughened transverse opacity appears in the lower third of the cornea of eyes which have long been blind from iridocyclitis, sympathetic ophthalmia, and glaucoma. Under such circumstances it is proper to remove the blind eyeball.

Conical Cornea is a cone-shaped bulging forward of the cornea. It is most common in women, and usually does not develop until after the age of fifteen. Exhausting illness, menstrual disturbance, and chronic types of dyspepsia have been assigned as exciting causes. In most instances the cone is transparent. Occasionally its apex is slightly opaque. The eyeball becomes enormously myopic and highly astigmatic. Slight forms of conical cornea are best detected by means of the shadow test.

Although no form of glasses may avail in advanced cases, a careful trial should always be made with sphero-cylindrical combinations, and in some instances their employment in unusual combinations will markedly improve vision. Eserine, $\frac{1}{8}$ grain to the ounce, should be

employed for several weeks before attempting the correction, as suggested by Wallace.[1] If the apex of the cone appears to be thinning, the use of a weak solution of sulphate of eserine and a compressing bandage are indicated.[2] In advanced cases an operation is advisable, having for its object the substitution of a contracting cicatrix for the tissue at the apex of the cone. Several plans have been suggested: (*a*) Cutting off a small, superficial flap, and subsequently cauterizing the surface, associated with repeated paracentesis of the cornea, and later a small iridectomy for optical purposes. (*b*) Cutting off the flap and drawing the edges of the wound together with delicate sutures. (*c*) Cutting from the apex of the cone a small disk with a trephine. (*d*) Multiple punctures with fine needles. (*e*) Obtaining the desired loss of substance with the application of the galvano-cautery.

Buphthalmos.—In this affection there is a slow but progressive enlargement of the eye in all its diameters. The cornea is flattened, the sclera thinned, the anterior chamber deepened, and the tension raised. The affection appears at birth or shortly afterward. It has been ascribed to an intra-uterine irido-keratitis with increased intra-ocular tension; in other instances a form of congenital glaucoma. The prognosis is unfavorable. Iridectomy and sclerotomy have been practised with poor success, but Theodor Arnold[3] considers that the latter operation produces the best and most lasting results. Eserine or pilocarpine may be tried.

Erosions are superficial losses of epithelium caused by contact with some sharp substance. The treatment consists of the instillation of an antiseptic lotion, such as bichloride of mercury, and the use of atropine and a compressing bandage to immoblize the lids until healing takes place. A number of cases in which violent neuralgic pain has followed an insignificant scratch of the cornea have been reported. This condition is called *traumatic keratalgia*. It may last for years, and is probably due to a neuritis of a corneal nerve. Antipyrine has seemed to be useful in some of these cases.

Tumors of the Cornea are very rare. Epithelioma and sarcoma of the limbus may occur. In most instances enucleation would be required. Dermoid tumors appear as congenital growths, and consist of firm, hemispherical, yellowish-white growths lying partly upon the cornea and partly upon the conjunctiva: the apex is often covered with hairs. Usually they may be dissected from their base without difficulty.

[1] *University Medical Magazine*, vol. i. p. 231.

[2] Steinheim, *Arch. f. Augenheilk.*, ix. 3, S. 253, 1880.

[3] *Beiträge zur Augenheilkunde*, Hamburg und Leipzig, 1891, iii. Heft. p. 28.

DISEASES OF THE SCLERA.

THE sclera is in such intimate connection by its under surface with the choroid and ciliary body that, in addition to the diseases peculiar to itself, it is liable to changes indicative of lesions in these subjacent structures. The close anatomical connection between the cornea and sclera renders the former liable to become involved in affections of the latter.

Episcleritis is an affection of the episcleral tissue, and occurs in the form of small, dusky-red, subconjunctival swellings, which commonly develop in the ciliary region on the temporal side of the cornea, although they may be located elsewhere in the sclerotic coat. The conjunctival vessels over the patch are densely injected, the episcleral vessels present a dusky congestion, and the elevation is usually tender to pressure. The disease runs a subacute course, reaching its height in about three weeks; then gradually disappears, leaving a dull area of discoloration to mark its former position. Relapses are frequent, either at the seat of the original disease or in new areas.

So far as sight is concerned, the prognosis is good, but unfavorable on account of the frequent recurrences. This form of superficial scleritis is said to be more common in men than in women (Nettleship). It usually attacks adults past middle life. Patches of episcleritis of the character described occur in the eyes of those who are much exposed to weather. In other cases it is caused by rheumatism, scrofula, menstrual derangements, and again appears without cause.

TREATMENT.—This consists in the use of atropine to allay pain and prevent any tendency to iritis, warm antiseptic collyria, and hot compresses. In chronic types eserine and pilocarpine locally have a beneficial influence, provided no iritis is present. Eserine may be employed in the strength of $\frac{1}{4}$ to $\frac{1}{12}$ of a grain to the ounce, several drops three times a day. Massage, with or without the use of the yellow oxide of mercury, is very useful in chronic cases. It may also be employed, according to Pedraglia,[1] in acute cases.

The following operative measures may be employed: (*a*) Scarification of the tumefaction, although Adamük[2] thinks that in many cases simple incisions are not sufficient. (*b*) Curetting with a sharp spoon or similar suitable instrument. Thus, Wicherkiewicz,[3] after loosening the conjunctiva, removes with a small sharp spoon the soft spongy tissue until healthy tissue appears. (*c*) Cauterization with the actual cautery. Webster[4] is particularly emphatic in the praise of this method. Internally salicylic acid and iodide of potash are needed in rheumatic cases, and good results follow diapho-

[1] *Centralbl. f. prak. Augenheilk.*, S. 111, 1881. [2] *Ibid.*, S. 12, 1881.
[3] *Ibid.*, Oct., 1880. [4] *International Journal of Surgery and Antiseptics*, Jan., 1888.

resis either by the exhibition of jaborandi or by Turkish baths. Very often a change of residence is desirable, and especially the use of those waters which are known to have an antirheumatic tendency. In Germany, Pagenstecher has recommended, in recurring episcleritis, the use of the waters and baths of Wiesbaden.

Scleritis.—This is an inflammation of the sclera itself, and appears in the form of a diffuse, bluish-red injection occupying the entire exposed portion of the sclera, very painful, unattended with secretion, save some increase in lachrymation, and liable to be mistaken for conjunctivitis or iritis; or it occurs in the form of circumscribed patches of violaceous tint, situated in the ciliary region and resembling in appearance the forms of superficial episcleral elevation which have just been described. Deep forms of scleral inflammation almost always affect other portions of the eye—the uveal tract and the vitreous.

The *causes* of deep scleritis are exposure to cold, rheumatism, gout, scrofula, vaso-motor changes, disturbances of the sexual apparatus (especially anomalies of menstruation), syphilis (forming the so-called gummatous scleritis), and gonorrhœa, when this also causes synovitis. One type of scleritis, sometimes called *sclero-keratitis*, is seen in young and middle-aged subjects, especially women with depressed nutrition who may or may not have a scrofulous disposition or inheritance.

In deep scleritis both eyes are usually attacked. It runs a chronic course, commonly affects the iris and cornea, and may lead to disease of the ciliary body, choroid, and vitreous.

When the disease is characterized by chronicity, relapses, and involvement of the cornea and iris, it receives the name *sclero-kerato-iritis*. This is a very stubborn and distressing affection. It begins with a deep scleritis of the ciliary zone; the cornea which lies adjacent becomes opaque and sometimes ulcerated; iritis occurs. After a few weeks the symptoms subside, a discolored area marks the seat of the affection, and some haziness in the cornea remains. Then a relapse takes place, with fresh scleritis, new corneal changes, renewed iritis, irido-choroiditis, and vitreous changes, and finally the whole eye will be deprived of vision, owing to extensive changes in the cornea and in the uveal tract.

Treatment.—The treatment of scleritis and the types of sclero-choroiditis and sclero-kerato-iritis depends upon the type and stage of the disease and the presence or absence of definite cause. In most respects it resembles the methods which have already been described in connection with Episcleritis. Locally, atropine, hot compresses, cocaine- and boric-acid lotions, and in painful cases leeches to the temple, are suitable. In rheumatic cases salol, the salicylates, the alkalies, and iodide of potash are the most valuable remedies. In

gouty cases carefully regulated diet, mineral waters, citrate of lithium, colchicum, especially in the form of colchicin (Darrier), and changes of climate are needed. Scrofula requires the usual treatment. In any case sweats with pilocarpine or the fluid extract of jaborandi are most efficacious. In the absence of these the systematic use of Turkish baths may be recommended. In gummatous scleritis bichloride of mercury and inunctions of mercurial ointment are probably the most suitable remedies. Indeed, as a means of altering the nutrition of the part and preventing exudation into the uveal tract these drugs are suited to scleritis from any cause. Scleritis occurring in women should always lead to the investigation of the pelvic viscera. Scleritis in subjects of depressed nutrition in addition to the local measures should be treated by a general tonic regimen. Quinine and arsenic are efficacious. The use of the actual cautery has already been described, and is applicable to relapsing types of this affection. It is not always possible to distinguish between episcleritis and scleritis, and the treatment as well as the causes of the two conditions is similar.

Staphyloma of the Sclera, or a bulging of this membrane, may be caused by chronic glaucoma, kerato-iritis and closure of the pupil, inflammation of the ciliary body, thinning of the scleral coat by repeated attacks of inflammation, tumors, and wounds closed by non-resisting scars.

In a single scleral staphyloma vision may not be destroyed; in most forms, however, resulting from chronic disease of long standing, the eye is useless and enucleation is indicated.

Abscess and Ulcer of the Sclera are exceedingly uncommon. The former may occur from an infected wound, and has been seen in connection with certain specific and contagious diseases. A gumma, tumor, or tubercle in some other region of the eye may break down and ulcerate into the sclera. Leber[1] has described a spontaneous episcleral abscess, with otherwise normal conditions in the eyeball, which after puncture and evacuation of the pus went on to complete recovery.

Tumors of the sclera are rare growths. The following have been seen: fibroma, sarcoma, enchondroma, and osteoma. In some instances it has been possible to dissect small, primary scleral growths from their beds and close the wounds with conjunctival sutures.

[1] *Archiv f. Ophthalmologie*, xxvi. S. 263, 1880.

DISEASES OF THE IRIS AND CILIARY BODY, SYMPATHETIC OPHTHALMIA, AND OTHER SYMPATHETIC AFFECTIONS.

By CHARLES J. KIPP, M. D.

DISEASES OF THE IRIS.

The different forms of inflammation of the iris will be considered here under the headings of plastic, serous, and purulent iritis.

Acute Plastic Iritis.

In the treatment of plastic iritis, from whatever cause, the first indication is to secure complete dilatation of the pupil, and to maintain the same for some time after all inflammatory symptoms have disappeared. In the so-called serous form of this disease and during the first stage of the plastic variety this is accomplished without difficulty by a few instillations of a solution of sulphate of atropine. The following is the formula commonly used:

℞. Atropinæ sulph.,	gr. iv;
Aquæ destill.,	f℥j.—M.

If posterior synechiæ have already formed when the case comes under observation, a drop of the above solution should be instilled five or six times at intervals of five minutes, and if this should fail to break up all the adhesions between the iris and the anterior capsule of the lens within an hour after the first instillation, a 2 per cent. solution of hydrochlorate of cocaine should be instilled at the same time and in the same manner as the solution of atropine, or the atropine and the cocaine may be combined in one solution, and then applied as above directed; I usually employ this formula:

℞. Atropinæ sulph.,	gr. ij:
Cocainæ hydrochlor.,	gr. iv;
Aquæ destill.,	f℥ss.—M.

A stronger solution of atropine than the one above given is occasionally necessary to break up broad and firm adhesions. The following formula may be used for this purpose:

℞. Atropinæ sulph.,	gr. iv;
Cocainæ hydrochl.,	gr. iv;
Aquæ destill.,	f ʒss.—M.

This solution should, however, never be entrusted to the patient, but should be applied only by the physician or by a competent nurse. Care should be taken to place a drop of the solution directly on the cornea while the lids are held open during and for some seconds after the instillation. The drop may be applied every five minutes for half an hour.

After a widely-dilated, round, or nearly round pupil has been obtained, the weaker solution of the atropine, without the cocaine, may be substituted for the stronger, and need be dropped in the eye only sufficiently often to maintain the dilatation. This is usually accomplished by from three to six instillations daily. If, however, after the lapse of an hour or two from the last application of the strong solution, the pupil is only slightly or irregularly dilated, the stronger solution may be applied in the manner above described two or three times daily for several days, until it is evident that atropine alone cannot break up the synechiæ. Instead of this solution some physicians prefer to place a small particle of sulphate of atropine in substance in the conjunctival sac. Constitutional symptoms of atropine-poisoning are, however, not rarely observed after the use of the stronger solution and the atropine crystals.

An ointment of sulphate of atropine, such as the following,

℞. Atropinæ sulph.,	gr. ij;
Vaselini,	f ʒss.—M.,

is preferred by some physicians, as it is supposed to be less liable to produce conjunctival irritation than the solutions. A small piece of the ointment is put in the conjunctival sac five or six times at intervals of five minutes. Gelatin disks containing atropine in different quantities, alone or in combination with cocaine, are now in the market, and are highly spoken of by some physicians. They are taken up from the box by a moistened soft camel's-hair pencil, and then placed on the scleral conjunctiva toward the outer canthus. The patient must close the eye at once. As soon as one disk is dissolved, another may be applied till the desired effect is obtained.

If the atropine drops or the ointment entrusted to the patient should

fail to maintain the dilatation of the pupil, inquiry should be made as to whether the solution or the ointment has been applied as directed, for often very little of the drug reaches the eye when the application is made by an untrained hand.

If, as is occasionally the case even when the weaker solution is used, the application of the sulphate of atropine produces symptoms of poisoning, such as redness of skin, dryness of mouth and fauces, great thirst, a quick and weak pulse, palpitation, headache, delirium, ischuria, etc., it is due to the passage of the atropine through the lachrymal canal into the pharynx. This should, if possible, be prevented by using not more than a drop at a time, and by everting the puncta during and for some moments after the instillation, or by occluding the canaliculi by pressing the finger on the inner canthus. The same object can also be accomplished by placing a Liebreich's[1] or Tansley's[2] clamp on each canaliculus, or by inclining the head toward the side of the affected eye and then placing the drop in the outer angle.

If signs of atropine-poisoning supervene, the drug must be suspended and a hypodermic injection of sulphate of morphine (gm. 0.01 to 0.015 = $\frac{1}{6}$ to $\frac{1}{4}$ grain) should be given, and repeated if necessary. Alcoholic stimulants may be administered at the same time.

If the adoption of the precautions during the instillation here mentioned is not successful in preventing the poisoning, some other mydriatic must be substituted. The sulphate of duboisine, the sulphate of hyoscyamine, or the sulphate of daturine may be used for this purpose. Of these duboisine is probably most extensively used, as it is more certain in its action on the pupil than the others; but, unfortunately, it is apt to produce constitutional disturbance in the very cases which have an idiosyncrasy against atropine. The duboisine, hyoscyamine, and daturine should not be used stronger than in 1 per cent. solutions:

℞. Duboisin. sulphat.,	gr. ij;
Aquæ destill.,	f℥ss.—M.
℞. Hyoscyamin. sulph.,	gr. ij;
Aquæ destill.,	f℥ss.—M.
℞. Daturin. sulph.,	gr. ij;
Aquæ destill.,	f℥ss.—M.

Cocaine may be added to either of these solutions in cases accompanied by much pain. I have used sometimes, in young children, who are easily poisoned by even weak solutions of atropine, carefully applied

[1] *Zehnder's klinische Monatsblätter*, vol. ii. p. 411.

[2] *Transactions of the American Ophthalmological Society*, 1888, p. 63.

to the eye, the hydrobromide of homatropine in 3 per cent. solution, combined with an equal amount of cocaine, and have never seen unpleasant symptoms follow its use:

℞. Homatropin. hydrobromat.,	gr. vj;
Cocainæ hydrochl.,	gr. vj;
Aquæ destill.,	f℥ss.—M.

The effect of the homatropine on the pupil is, however, much more transient than that of either of the other mydriatics mentioned, and it is therefore necessary to repeat the instillation very often.

If, after a careful trial, it is found that all of the foregoing drugs in the strength of solutions here given produce symptoms of intoxication, weaker solutions may be tried till one is found that does not cause poisoning.

In old people the long-continued use of either of the mydriatics not unfrequently causes tenesmus and retention of urine.

The prolonged use of either of the above-mentioned mydriatics occasionally produces considerable irritation of the conjunctiva and inflammation of the integument of the lids. In some cases I have seen well-marked follicular conjunctivitis and an inflammation of the skin of the lids and cheek closely resembling erysipelas follow their use. In such cases it is best, if it can be done safely, to suspend the use of the alkaloid altogether for a while, and to apply a 1 per cent. solution of nitrate of silver or sulphate of zinc to the conjunctiva, and an ointment of oxide of zinc or acetate of lead to the skin, until the irritation has subsided, and then to resume the use of the same or some other mydriatic. If all the alkaloids mentioned cause irritation, a strong, well-filtered watery extract of belladonna may be substituted. In some cases a 1 per cent. solution of alum or borax, instilled three or four times daily as soon as signs of irritation show themselves, will reduce it sufficiently to allow the continued application of the alkaloid. Notwithstanding the disadvantages here mentioned of atropine, I think that, on the whole, it is to be preferred to all other mydriatics.

In cases of iritis of longer standing, in which the tissue of the iris is much swollen and infiltrated, and in which the aqueous humor is very turbid, or there is a gelatinous or spongy exudation in the pupil or in the anterior chamber, even the stronger solution of sulphate of atropine, instilled in the manner described, will, however, not only occasionally fail to dilate the pupil, but will in some very rare cases even increase the irritability of the eye. Under such circumstances it is advisable to employ at the same time other measures to reduce the inflammation. Of the various measures used for this purpose, none has in my hands given more satisfactory results than the local abstrac-

tion of blood by means of four to eight leeches applied to the temple. In many of the writer's cases, in which, before the application of the leeches, atropine failed to act, complete or, at least, partial dilatation of the pupil followed the leeching, and this took place often before the instillations were resumed. In localities where leeches are scarce, or in cases in which it is desirable to avoid the disfigurement resulting from the little scars, Fischer's plan of making a single leech do the work of many may be tried. It consists in making a long incision in the side of the leech after it has well filled itself. It is said that a leech thus treated will take from one to two ounces of blood if the wound in its side is kept free from clots. The artificial leech of Heurteloup may be employed when no leeches are at hand. After the abstraction of blood the patient should be kept in a dark room, or should at least remain quietly in a darkened room, for twenty-four hours or longer. If only slight improvement follows the leeching, it can be repeated several times at intervals of several days. In cases in which the abstraction of blood is contraindicated by marked anæmia, a considerable reduction of the inflammation of the iris is sometimes brought about by the action of a brisk cathartic. The continued application of hot-water compresses to the eye is often also of assistance in reducing the inflammation. In some cases in which atropine alone failed to break up adhesions the writer has seen complete and regular dilatation of the pupil follow shortly after the patient had taken a Turkish bath.

The measures thus far described will in many cases of iritis suffice to break up all or at least most of the posterior synechiæ; and when this has been accomplished the backbone of the disease is broken, and nothing remains to be done but to keep the pupil dilated for some weeks after all circumcorneal injection has disappeared, and to prevent the patient from using his eye during this time.

In cases of great intensity constitutional treatment will be required, however, to subdue the inflammation and remove the exudation. The appearance of circumscribed yellow nodules, so-called gummata or condylomata of a yellowish-red color, at the pupillary margin or at the periphery of the iris, is commonly regarded as a sure sign of syphilis, for which mercury must be administered. The writer has, however, seen at least two cases—one in a youth with inherited syphilis, the other in a man without any other symptom of syphilis and who denied exposure—and in both cases the nodules entirely disappeared under the use of the salicylate of sodium in 20-grain doses given every two hours till the physiological effects of the drug were obtained, and after that at greater intervals.

As a rule, it will be best in such cases to administer mercury, even when no other symptoms of constitutional syphilis are present. Inunction with blue ointment or the oleate of mercury is to be preferred in

most cases. From 30 to 60 grains of the strong mercurial ointment should be rubbed in daily and in different parts on successive days. The inner sides of the arms and thighs and the sides of the chest and abdomen are generally selected for the inunction. The oleate of mercury, 10 to 20 per cent., may be applied in the same manner as the ointment. The mercurial vapor bath is preferred by some physicians for introducing mercury into the system. A bath may be taken every night or every other night till the nodules have disappeared, 20 to 30 grains of calomel or black oxide of mercury being volatilized with each bath. In cases in which the nodules grow rapidly, no time should be lost in getting the system under the influence of the mercury, and in such cases small doses of calomel, $\frac{1}{10}$ of a grain, should be administered several times daily in addition to the inunction or bath till the gums swell.

If it is not practicable to make the inunctions or to use the baths, the drug must be given internally. Any one of the following preparations may be selected: The protiodide of mercury, in doses of $\frac{1}{4}$ to $\frac{1}{2}$ grain three times daily; the bichloride, in doses of $\frac{1}{20}$ to $\frac{1}{12}$ of a grain three times daily, in pills or in solution; calomel, in doses of $\frac{1}{20}$ to $\frac{1}{2}$ of a grain three or four times daily; blue pill, in doses of $\frac{1}{2}$ to 2 grains three times daily; mercury with chalk, in doses of $\frac{1}{2}$ to 2 grains, with or without Dover's powder, every two, three, four, or six hours, according to circumstances. Iron, quinine, or opium may be combined with any of the foregoing preparations if it is thought best to do so. The bichloride, the albuminate, and the peptonate of mercury may also be injected subcutaneously, in doses of $\frac{1}{12}$ to $\frac{1}{6}$ of a grain daily. The injections are, however, painful, and frequently cause the formation of abscesses at the point of injection, and seem to have no advantages over the administration of the drug by inunctions or by the mouth. In whatever form the mercury is given, great care should be taken to avoid salivation. The teeth and gums should be cleansed with a soft brush after each meal, and the mouth frequently washed with a solution of chlorate of potassium. Smoking should be avoided.

Iodide of potassium or iodide of sodium, alone or in combination with mercury, should be given for some time after the gummy tumors have disappeared. The iodide of potassium may be given in doses of 5 to 30 grains or more three times daily.

In cases with much turbidity of the aqueous humor, or with spongy or gelatinous exudation on the iris or in the pupil and the anterior chamber, free diaphoresis has often seemed to me to hasten the absorption of the exudation. The salicylate of sodium, in doses of 10 to 20 grains every two hours till decided tinnitus aurium is produced, and after that in smaller doses and at longer intervals, is most useful for this purpose. If a swallow of iced water is taken before and after the

medicine, and the drug itself is given in a considerable quantity of cold water, this remedy can usually be taken for some time without producing nausea. The muriate of pilocarpine, in doses of $\frac{1}{6}$ to $\frac{1}{3}$ grain once daily, may be used for the same purpose. The writer has usually given it by injection under the skin. In some cases this remedy produces great depression, and it should therefore be given in small doses at first. The depression requires the use of stimulants.

Iodide of potassium and iodide of sodium the writer has also given largely in cases in which salicylate of sodium could not be taken.

Sulphate of quinine is also useful in such cases.

In former years the writer used mercury in the class of cases under consideration much more frequently than he does now, having learned that the remedies above mentioned usually accomplish the object for which they are given. He now gives mercury only where these remedies, after a fair trial, fail to produce the desired result.

For the relief of the pain which is so frequently present during the early stages of iritis the repeated application of leeches to the temple is sometimes advisable, even if the pupil is widely dilated; and this plan is to be especially recommended in cases in which salicylate of sodium or sulphate of morphine does not act pleasantly. The salicylate of sodium sometimes acts like magic in relieving the pain, but, unfortunately, it also occasionally fails. Morphine, with or without sulphate of atropine or quinine, should always be given in sufficient doses, either hypodermically or by the mouth, if the salicylate fails to allay the pain and produce sleep at night. Chloral and antipyrine, in doses of 10 to 20 grains, may answer for the milder cases.

If the pain is due to an increase of the tension of the eyeball, and none of the remedies mentioned give relief, paracentesis of the anterior chamber should be resorted to. The opening is best made with a lance-shaped knife (Figs. 108 and 109) or a broad needle (Fig. 111) at the outer margin of the cornea, great care being taken that the instrument is not passed far enough in the chamber to wound the capsule of the lens. If necessary, this little operation may be repeated daily for several days.

In nearly all cases of iritis considerable relief from pain is also obtained from the application to the lids of cloths wrung out of warm water or warm solutions of morphine and extract of belladonna. In a few cases the application of iced cloths will be found more soothing to the eye, and the choice between the two may therefore be left to the patient.

Rest in bed in a darkened room, although perhaps not essential to complete and speedy recovery in the milder cases of iritis, should be insisted on in all cases in which there is much pain, œdema of the lids, and chemosis, spongy or gelatinous exudation in the anterior chamber,

or marked increase of tension. As long as the eye is at all irritable all close work should be strictly prohibited, even if but one eye is affected; and in order to guard against relapse as much as possible only a very cautious use of the eyes should be permitted for months afterward.

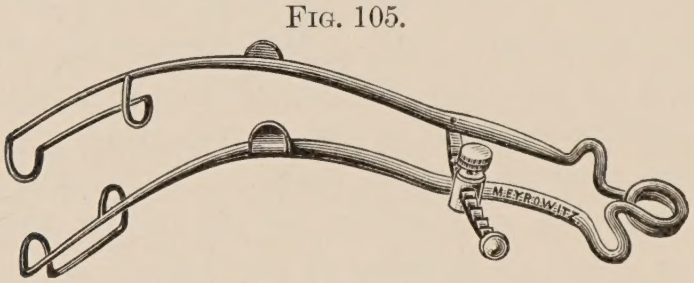
Chronic Plastic Iritis.

In this form of iritis it is rarely necessary to resort to the abstraction of blood or to give remedies for the relief of pain. An attempt should be made to break up the adhesions that have formed by means of the strong solution of atropine, as directed in the acute form. But if the pupil is excluded—that is, if the entire pupillary margin is fastened to the lens capsule, as it frequently is when such cases come under observation—no time should be lost in making an iridectomy. No other treatment will be of any avail in restoring communication between the anterior and posterior chambers and preventing secondary glaucoma and total blindness.

THE OPERATION OF IRIDECTOMY.

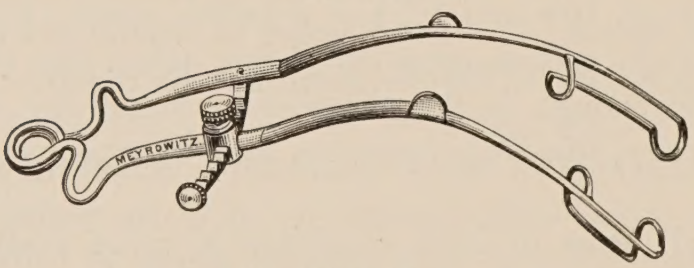
Instruments Required.—A spring speculum (Figs. 105 and 106); a

Fig. 105.



For Left Eye.

Fig. 106.



For Right Eye.

fixation forceps (Fig. 107); a straight (Fig. 108) or bent lance-knife (Fig. 109); a Von Graefe's narrow cataract knife (Fig. 110); a straight (Fig.

Fig. 107.

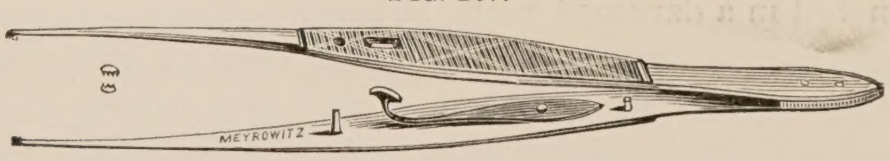


FIG. 108.

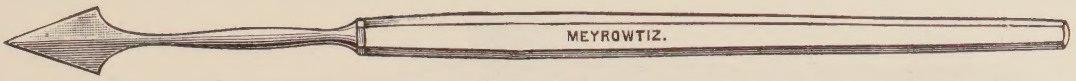


FIG. 109.

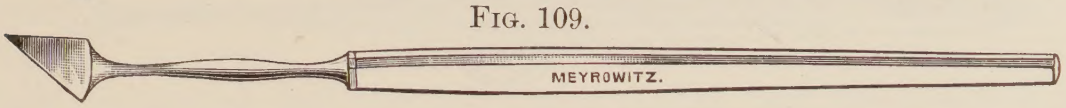


FIG. 110.

FIG. 111.

FIG. 112.

FIG. 113.

112) and a bent iris forceps (Figs. 113 and 114); iris scissors, bent (Figs. 115 and 116) or flat (Fig. 117); a Wecker's forceps scissors (Fig. 118); a spatula (Fig. 119).

FIG. 114.

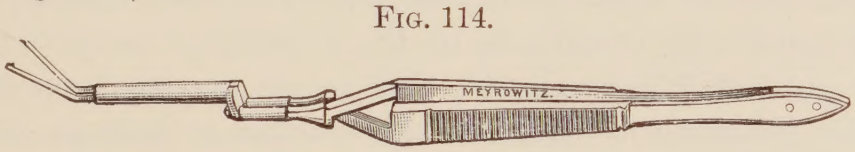


FIG. 115.

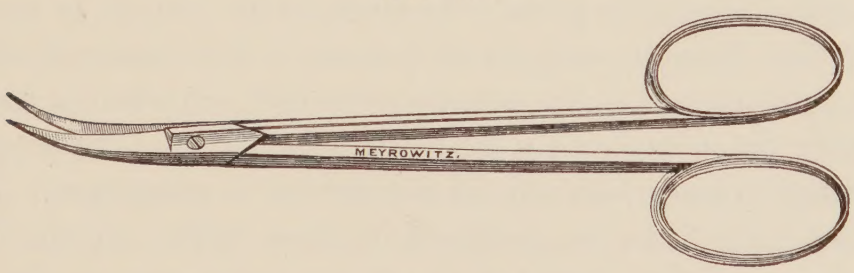


FIG. 116.

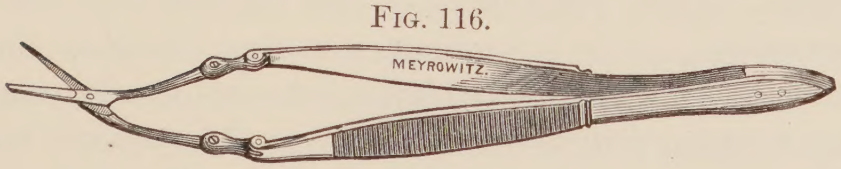


FIG. 117.

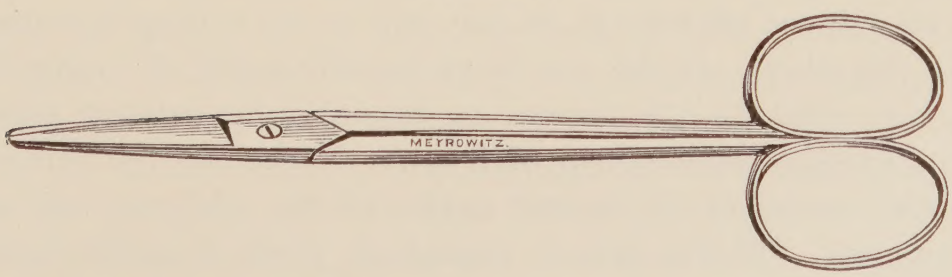


FIG. 118.

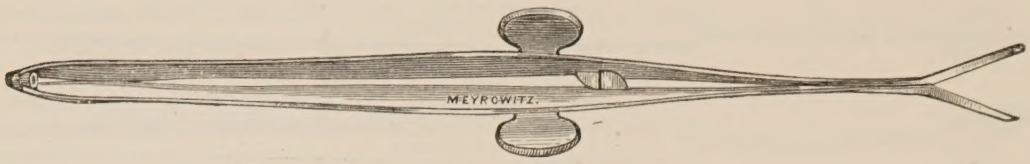


FIG. 119.

Ether or chloroform should be administered for operations on eyes with inflammatory affections. Cocaine will answer in most other affections.

Wash out the conjunctival sac before the operation with a solution of corrosive sublimate 1 : 5000.

The patient should be on a couch or table if ether or chloroform is administered; otherwise the operation can be done in a chair.

Introduce the spring speculum and open the lids to the desired extent. Take hold of a fold of conjunctiva with the fixation forceps in the left hand, close to the cornea, at a point opposite to that selected for the incision. If a lance-knife is used, enter the point almost perpendicularly at the limbus conjunctivæ or a short distance from it in the cornea, and push it in until it is visible in the anterior chamber. Now depress the handle of the knife, and push the blade forward parallel to the iris until the incision is of the required size (6 to 8 mm.). Withdraw the knife very slowly, and in doing this keep the point very close to the posterior surface of the cornea, so as to avoid wounding the lens, which advances as the aqueous fluid escapes. If a narrow cataract knife is used, the point is to enter in the limbus or in the clear cornea not far from it, and directed toward the centre of the pupil. When the point is well in the anterior chamber, depress the handle and push through the chamber to the point selected for counter-puncture. Then continue to push forward till the section is completed. The narrow cataract knife is to be preferred in cases with very shallow anterior chambers. After completion of the incision pass the fixation forceps to an assistant, who is to rotate, not drag, the globe downward. Pass the iris forceps with closed blades into the anterior chamber to the pupillary margin, then open the blades to the required extent and grasp the iris. Draw the forceps with the iris well out of the wound, and, with the scissors or Wecker's forceps scissors held close and parallel to wound, cut off the iris in one snip or by cutting first one end and then the other. If the iris be prolapsed, it will of course not be necessary to pass the iris forceps so far into the anterior chamber. After the excision of the loop of iris, see if the iris remains entangled in the wound or if the cut angles of the sphincter are not in proper position. If the iris is entangled, push it gently into the

anterior chamber with a spatula; if the cut angles of the sphincter are not in their proper place, rub the upper lid gently from angle of incision toward the centre of cornea, or do the same with the convex surface of a curette. If this should fail, the spatula must be cautiously introduced, and the cut angles pushed into the proper place. Blood in the anterior need not be removed: it will be absorbed in a short time. After completion of the operation wash out the conjunctival sac, as at the beginning, and bandage both eyes with sterilized dressings. Keep the patient in bed for several days.

In most cases of chronic iritis the ciliary body and the choroid are implicated, and the treatment recommended for these diseases is applicable also to the iritis.

Serous Iritis.

Synonyms: Keratitis punctata, Aquæ capsulitis, Hydromeningitis, Descemetitis.

In the disease designated serous iritis the inflammation is rarely limited to the iris; in most cases it extends to the ciliary body and the choroid, sometimes also to the retina. The name of serous uveitis, therefore, would be more appropriate. In the disease under consideration there is frequently no tendency to the formation of posterior synechiæ, at least not in the early stages of the disease, and the pupil is readily dilated by weak solutions of atropine. The pupil should be kept dilated by atropine throughout the course of the disease, except in cases with marked increase of the intraocular tension or in cases in which pain is caused by the atropine. In such cases the use of mydriatics is best avoided. Myotics would seem to be indicated here, but in cases with considerable increase of tension in which the writer used weak solutions of salicylate of eserine the result was not satisfactory, as in each case posterior synechiæ were formed, which could not be broken up by atropine. In other cases of this kind he tried a 1 and 2 per cent. solution of the muriate of pilocarpine, and while no posterior synechiæ were produced by this drug, it failed to reduce the tension of the eye. A decided increase in the tension of the eye, lasting for several days, requires a paracentesis of the anterior chamber, which may be repeated for several days if necessary, till the tension remains normal. In cases of much pain with deep anterior chambers the same operation may be performed. (For a description of the operation see treatment of Plastic Iritis.) In this form of iritis, as in the plastic, much benefit is often derived from free diaphoresis, lasting several hours, repeated daily or every other day. The salicylate of sodium or muriate of pilocarpine, administered as described above, will answer the purpose. The Turkish bath is also useful in this disease. Saline cathartics should be given once or twice a week. Diuretics, such

as the acetate of potassium, bitartrate of potassium, and the nitrate of potassium, may be given from time to time. The writer has, however, derived apparently more benefit in such cases from the long-continued use of iodide of potassium than from any other remedy. It should be given in doses of from 7 to 25 grains or more, largely diluted in water or Vichy water, three times daily. In very obstinate cases small doses of mercury should be tried, and continued if improvement follows. Blisters and setons on the temple or back of the ears were formerly much in favor in the treatment of this disease, and there can be no doubt that in chronic cases blistering is occasionally followed by a decided decrease in the number of precipitates on Descemet's membrane. As no harm can come from it, a succession of blisters to the temples may be tried in cases of long standing. Setons and issues inserted into the temple are very rarely employed at this day, and their utility is indeed very doubtful. The mixed form of sero-plastic iritis must be treated as the plastic form.

Purulent Iritis.

In this variety of iritis the local treatment recommended for the plastic form should be given a fair trial. But if this does not succeed in dilating the pupil in a reasonable length of time, or the mydriatics increase rather than diminish the inflammation, their use must be suspended. If the hypopyon is small, hot-water compresses applied steadily for several days will sometimes cause its disappearance; if they do not, or if the hypopyon fills half of the anterior chamber when the case is first seen, the pus should be evacuated by paracentesis of the anterior chamber. This operation may be repeated after several days if necessary. No remedies will, of course, be of any service if the purulent iritis is only a part of a general suppurative inflammation of the globe, as it frequently is. Otherwise, mercury may be administered as directed for gummy tumor of the iris; and if this should fail to diminish the inflammation, salicylate of sodium or iodide of potassium may be administered. (For further particulars see also article on Panophthalmitis.)

Syphilitic Iritis.

Iritis occurring in connection with secondary symptoms of syphilis may present itself under any one of the forms of iritis previously described, and must be treated accordingly. As a rule, the patient should be got rapidly under the influence of mercury. After the iritis has disappeared the iodide of potassium should be prescribed. (See article on Syphilis, Vol. II.)

Rheumatic and Gouty Iritis.

This condition requires, in addition to the local treatment of plastic iritis, internally salicylate of sodium, salicylate of lithium, tartrates of sodium and potassium, liquor potassæ, iodide of potassium, pilocarpine, colchicum, oil of turpentine, Chian turpentine, oil of gaultheria, or quinine. The mode of administering salicylate of sodium and pilocarpine has already been described. The iodide of potassium may be given in combination with colchicum. The oil of turpentine should be given in doses of from 5 to 60 drops in the form of an emulsion or in capsules. The oil of gaultheria is given in doses of 15 drops in capsules three times daily. In many cases it will be found necessary to give morphine or chloral at night to procure sleep. Quinine will often relieve the pain if it is not of great intensity.

Gonorrhœal Iritis.

This disease requires the same treatment as the rheumatic form. The urethral disease should of course be controlled as speedily as possible. In this form of iritis the pain is sometimes almost unbearable during the first two weeks of the disease, and requires for its relief large doses of morphine frequently repeated. The salicylate of sodium is in most cases of this kind to be preferred to other remedies, but if it cannot be taken quinine in large doses may be given. After the subsidence of the pain, iodide of potassium or muriate of pilocarpine may be administered for clearing the vitreous body. In nearly all cases of gonorrhœal iritis the inflammation involves the ciliary body and the choroid, and months are often required for the cure of the disease. Relapses are of frequent occurrence, and cannot be prevented.

Diabetic Iritis and the Iritis occurring in connection with Recurrent Fever and other Febrile Diseases.

Such an iritis may assume either the plastic, the serous, or the purulent form. The measures recommended for these forms are also to be employed here, provided that they do not have an injurious effect on the general disease.

Permanent Results of Iritis.

If only a few filiform posterior synechiæ remain, it is not advisable to interfere, as they do no harm. Attempts to break them up should not be made for many months after the subsidence of the inflammation. For this purpose strong solutions of myotics and mydriatics are alternately instilled. It is best to make an instillation of a $\frac{1}{4}$ per cent. solution of salicylate of eserine, and after a few hours instill several drops at short intervals of a 2 per cent. solution of sulphate of atropine.

It will be useless, however, to attempt to break up in this way broad and firm adhesions. For broad and firm synechiæ Stratfield, Passavast, and others have advised an operation for the detachment of the synechiæ (corelysis). It is rarely done at present. Previously to the operation the pupil is dilated as much as possible by a strong solution of atropine, so that the adhesions are readily visible. An incision is now made a little to the side of the adhesion by a broad needle. A small spatula hook is then introduced in the anterior chamber, passed behind the adhesion, and then slowly drawn toward the wound in the cornea. Great care must be exercised that the capsule of the lens is not ruptured. Passavast seizes the iris just above the adhesion with iridectomy forceps, and then draws it toward the wound. Atropine must also be used after the operation. Operative interference is, however, rarely required, except in cases in which the pupillary margin is completely adherent to the capsule of the lens. This condition, which is also called exclusion of the pupil, imperatively calls for the operation of iridectomy as soon as the communication between the anterior and posterior chamber is interrupted. Secondary glaucoma is sure to follow this condition unless communication is re-established. If the pupil is at the same time occluded, the operation may also greatly improve vision. The iridectomy should be as large as possible, and made upward. As in these cases the iris is greatly bulged forward and the anterior chamber is very shallow, the incision is best made with a narrow cataract knife in the limbus conjunctivæ. In cases in which the whole pigmentary layer of the iris is adherent to the anterior capsule of the lens, an iridectomy alone is of no use, as the pigmentary layer will remain *in sitû*. In such cases the lens must be extracted, and afterward an opening made in the membrane in the pupil. An iridectomy is also advised by some surgeons in all cases in which extensive synechiæ remain, in the hope of preventing relapses of the iritis. The writer, who in former years often followed this advice, has, however, seen relapses as often in cases in which an iridectomy has been made for this purpose as in cases not operated on. In the writer's opinion posterior synechiæ have little or nothing to do with the causation of relapses.

Injuries to the Iris.

Injuries to the iris alone are generally the result of blows, and are nearly always complicated with hæmorrhage in the anterior chamber. The blood usually disappears in a short time under the application of iced cloths to the lids. If iritis follows the injury, it must be treated by atropine, leeches, and cold applications. (See Plastic Iritis.) Traumatic iridoplegia is often due to small rents in the pupillary margin. The paresis usually passes away without treatment, but moderate dilatation of the pupil often remains for years.

Tumors of the Iris.

Cysts of the Iris.—Excision of the cyst, with the segment of the iris in which it is located, is the best treatment. Laceration by instrument is generally unsuccessful. In a case under the care of the writer the cyst was ruptured by the violent contraction of the pupil after the instillation of a 1 per cent. solution of sulphate of eserine, and no refilling of the cyst recurred while the patient was under observation —a month.

Sarcoma of the Iris.—If at all large and situated near the periphery of the iris, the tumor requires enucleation of the globe. If small, so that its base does not reach within two millimetres of the angle of the anterior chamber, its excision may be attempted. In a case of sarcoma of the iris under the writer's care the growth, together with a healthy strip of iris, was removed through a large incision of the cornea. The wound healed by primary intention. No relapse had occurred at the time the patient was killed by a railroad accident, five years after the excision of the tumor.[1]

Tubercles of the Iris.—In the early stages of this disease, while the tumors are small and not numerous, excision of the tubercles with the surrounding iris may be attempted. But if the disease involves much of the iris, the globe must be enucleated.

Functional Disturbances of the Iris.

Paralytic Mydriasis, without Paralysis of Accommodation.—The treatment of this affection must vary with its cause. In many instances syphilis is at the bottom of the trouble, and in such cases, if secondary symptoms are still present, mercury should be given, otherwise iodide of potassium in increasing doses will be demanded. In rheumatic cases remedies directed to the general disease should be administered. Mydriasis caused by poisoning through belladonna, stramonium, and hyoscyamus requires no treatment. Locally we may apply in all cases a weak solution of salicylate of eserine or of pilocarpine, which may be instilled sufficiently often to keep the size of the pupil equal to that of the other eye. In some cases a series of blisters applied to the temple or behind the ear may be of service. Galvanism has been tried and found to be of little or no utility. If it is thought advisable to employ it, care must be taken to use but few cells at first. The anode should be applied to the closed lids and the cathode to the temple.

Spastic Mydriasis is sometimes associated with migraine, in other cases with spinal meningitis. The treatment should be directed to the disease causing the mydriasis. If it is due to snake-bite, trichinosis, or poisoning from meat, it will pass away with the disease causing

[1] *Archives of Ophthalmology*, vol. v. p. 34.

it. If it is suspected that entozoa in the intestinal tract are the cause, measures for their removal should be adopted.

Myosis is frequently a symptom of hyperæmia or inflammation of the brain and its membranes. It may be due to hyperæsthesia of the retina or irritation of the cornea, chronic intoxication from morphine, nicotine, or alcohol. In other cases it is a symptom of peripheric paralysis of the cervical sympathetic. Myelitis, multiple sclerosis, progressive atrophy of the muscles, tabes, and progressive paralysis are among the diseases causing myosis. The treatment should be directed to the disease of which the myosis is a symptom. Locally, weak solutions of atropine may be tried, though the writer has never seen permanent benefit follow their use.

DISEASES OF THE CILIARY BODY.

Plastic Cyclitis.

This is rarely a primary disease; in most cases it is the result of the extension of the inflammation from the iris or choroid.

Plastic cyclitis requires about the same treatment as plastic iritis. Unless plastic iritis is present at the same time, mydriatics should not be used vigorously, and, if they increase the pain, must be abandoned entirely. The repeated abstraction of blood by means of leeches or the artificial leech is more often demanded here than in iritis. Of the internal remedies recommended, mercury is most useful in this disease.

Gummy Tumors of the Ciliary Body demand a vigorous antisyphilitic treatment. In a case of this kind lately under the care of the writer the gumma disappeared entirely under treatment, but in another case more recently seen by him the tumor had perforated the sclerotic and destroyed the eye, notwithstanding appropriate treatment under the direction of another physician. In the last-mentioned case it became necessary to enucleate the eye in order to relieve the patient of pain. In chronic plastic cyclitis sometimes nothing short of enucleation of the globe will relieve the pain.

Serous Cyclitis.

The treatment of this affection is identical with that for serous iritis. The tension of the eye and the field of vision should be frequently examined, and an iridectomy made if symptoms of glaucoma supervene. Pilocarpine will be of much assistance in clearing up the vitreous. Special attention should be given in chronic cases to the patient's general condition, and if the functions of other organs are deranged they should be corrected as far as possible.

Purulent Cyclitis.

This is commonly only a part of suppurative inflammation of the entire uveal tract. Wounds or general infectious diseases are generally the cause. The treatment advised for purulent iritis should be adopted for this affection. (Consult also article on Panophthalmitis.)

Injuries of the Ciliary Body.

Punctured and Incised Wounds of the Ciliary Body, if made by sharp and clean instruments, sometimes heal without leaving a puckered scar. At other times they cause a cyclitis of either the plastic or purulent form. Lacerated wounds and foreign bodies lodging in the ciliary body always cause a cyclitis. In cases with a punctured wound or a small incision in the sclerotic the conjunctival sac should be washed with a solution of corrosive sublimate, 1 : 5000, and the eye bandaged with sterilized material. After the wound has healed iced cloths may be applied to the eye and the pupil kept dilated with atropine, till all signs of irritation have subsided. The patient should be kept in bed in a darkened room. If the wound is long, the wound in the conjunctiva or in the sclerotic itself should be united by aseptic sutures, and then treated in the same manner as a small wound. If cyclitis should develop, leeches must be applied and the other measures advised for idiopathic cyclitis be carried out. If a part of the ciliary body is prolapsed through the wound in the sclerotic, it must be abscised and the wound in the conjunctiva united by sutures. In cases of large lacerated wounds, with or without a foreign substance in the ciliary body, it may be advisable to enucleate the globe at once. Enucleation is also to be done in all cases of traumatic cyclitis in which the measures advised for idiopathic cyclitis fail after a fair trial to quiet the pain and to prevent the total destruction of sight. So long as the ciliary region remains tender to the touch, especially if a foreign body remain in the eye, there is danger that sympathetic disease may develop in the other eye. If the patient can be kept under constant observation, enucleation may be delayed till signs of irritation show themselves in the fellow-eye; at the same time it must, however, be remembered that it is not always possible to arrest the progress of the disease even in this stage. Should panophthalmitis supervene on the cyclitis, enucleation of the globe in the first stage of the disease will spare the patient much pain and enable him to resume his work at a much earlier period than he would if the disease were allowed to go on.

Tumors of the Ciliary Body.

Sarcoma and endothelioma may originate in the ciliary body. Enucleation of the globe is the only remedy.

SYMPATHETIC OPHTHALMIA.

In view of the fact that we are very often unable to arrest the progress of sympathetic ophthalmia after it has once broken out, the adoption of measures for its prevention is of the utmost importance. Of the different measures recommended for this purpose at various times, only one has stood the test of time, and this is the enucleation of an eye in a condition of disease which experience has shown to be productive of sympathetic inflammation.

Optic neurotomy[1] and neurectomy[2] and evisceration of the globe[3] have been employed as substitutes for enucleation. The first of these procedures is now entirely abandoned, and the other two are practised rarely by others than their originators. The writer does not regard these procedures as safe substitutes for enucleation, and would employ them only in cases where enucleation is absolutely refused. (A description of the operations will be found at the end of this article.)

Prophylactic enucleation is indicated by the following conditions: I. Iridocyclitis with a foreign body in the eye and vision destroyed. If the foreign body is known to be a fragment of iron and useful vision is still present, an attempt may be made to extract the iron by the electro-magnet. If this is successful, the iridocyclitis may slowly subside and cease to be dangerous to the other eye. Such eyes require, however, close watching for a long time afterward. II. Iridocyclitis the result of a perforating wound, especially of the ciliary region, with entanglement of the iris or ciliary body in the wound and with total destruction of sight. III. A painful, shrunken globe, especially if a plate of bone can be detected in its interior.

While it is true that the conditions above enumerated are not always followed by sympathetic inflammation, and that enucleation has in a few cases failed to avert sympathetic disease in the other eye, yet the writer believes it to be the duty of a physician to advise the operation in such cases as the only safeguard we know of against the transmission of disease to the fellow-eye. An empty socket is surely not a pleasant sight, but it is far better to have it than to be constantly in danger of total blindness.

Enucleation may also become advisable as a prophylactic measure in cases of extensive injury to the globe which will probably be followed by total blindness and iridocyclitis. Here it is not absolutely necessary to operate at once, as the danger from sympathetic trouble is not great till the iridocyclitis in the injured eye is at its height. Yet it is best to do so in a person whose family is dependent on his labor

[1] Boucheron, *Annales d'Oculist.*, vol. lxxvi. p. 238.

[2] Schweigger, *Archives of Ophthalmology*, vol. xvi. p. 223.

[3] Albert Graefe, *Michel's Jahresbericht über die Ophthalmologie*, 1884, p. 309.

for daily bread, as it will cut short the period of confinement to his room, and also in persons who cannot be kept under observation for at least several months.

IV. The writer would also urgently advise the operation in cases of injuries which are likely to give rise to sympathetic trouble occurring in children, as in them the sympathetic inflammation is often developed suddenly without being preceded by signs of irritation.

The first symptoms of sympathetic inflammation may show themselves as early as eight days and as late as fifty years after the injury. Commonly, three to six weeks intervene between the injury to the one eye and the development of the disease in the other. In many cases premonitory symptoms precede the onset of the inflammation, but in others this does not occur. The premonitory symptoms consist of inability to read or to use the eye for fine work, for even a short time, without producing pain, circumcorneal injection, and lachrymation. There is often also marked impairment of the accommodation. The irritation subsides with the cessation of the work, but returns with every attempt to use the eyes. In many cases there is also marked photophobia and a neuralgic pain about the eye. The sight is not impaired. The irritation may pass away, and return and continue for weeks. The symptoms here described are regarded by some authors as due to a neurosis, and they apply to it the name of sympathetic irritation. In their opinion this irritation never passes into inflammation. This difference of opinion is, however, of no practical importance, as we are all agreed that the condition, if we are reasonably certain that it is caused by disease of the eye first affected, requires for its cure enucleation of the exciting eye. The only exception to this rule is to be made in cases in which the exciting eye has still useful vision and there is reason for the belief that it will not be lost through the disease. When symptoms of iridocyclitis or of optic neuritis or of neuro-retinitis have made their appearance, enucleation is often unable to arrest the progress of the disease. Indeed, it is held by some authors that the operation made at this period of the disease has an injurious influence on its course. Such is, however, not the case. The writer has again and again enucleated the exciting eye in cases of sympathetic iridocyclitis, and he has no reason to regret doing so. In all the cases of serous iridocyclitis in which this was done recovery took place, and vision remained good as long as the cases were under observation (several years). In two of these cases numerous atrophic spots were found in the choroid after the vitreous had cleared up. In all the cases operated on the exciting eye was blind and painful. The case is, however, different if the sympathetic disease is of the plastic variety and the disease has made much progress when first seen. Under such circumstances one may be in doubt, especially if the exciting eye is the better of the two

as far as vision is concerned. The writer's rule in such cases has been not to operate.

As regards the treatment of the eye sympathetically affected, it need only be said that it does not differ from that of idiopathic irido-cyclitis or of optic neuritis. The writer has usually given mercury in some form in these cases. Others prefer pilocarpine. If secondary glaucoma should supervene, a paracentesis or a sclerotomy must be made. The patient should be kept in bed in a darkened room till the inflammation has subsided, and if the eye is saved it should be protected against intense light for a long period. Absolute rest of the eye for several months should also be insisted upon. In cases in which the disease is not arrested no operative interference should be attempted for at least a year after the subsidence of all inflammatory symptoms. If the pupil is blocked and the iris adherent *in toto* to the lens capsule, an attempt to restore sight should be made only in cases in which the perception of light and projection are good and the tension of the eye is nearly normal. In such cases Schweigger[1] recommends a peripheric linear incision of the same length as in the operation for the extraction of cataract. If the anterior chamber is shallow, the knife on entering is pushed at once through the iris and the exudation membrane behind it, and carried across behind the iris to the point of counter-puncture. Then a pair of straight forceps is introduced in such a manner that one branch lies in front and the other behind the iris. The toughness of the membrane is, however, usually so great that the part of the iris in the branches of the forceps cannot be drawn out of the wound. It is therefore necessary to introduce the blades of a pair of fine scissors, one blade in front, the other behind the iris: a cut is first made on one side, and then on the other, in a radial direction toward the pupil. The flap so formed can generally be drawn into the wound and completely cut off. During the manœuvre a part of the corticalis usually escapes, and the remainder is then removed by manipulation or by a cataract spoon. After this operation the pupil frequently closes again, and no further operation should be attempted for months after the disappearance of all signs of irritation. Then an attempt may be made to obtain an opening in the obstructing membrane by iridotomy. Critchett[2] succeeded in two cases in restoring vision by the following operation: He introduced a fine needle through the cornea and directed the point to the centre of the opaque capsule, and, by making a rapid rotary movement on the principle of a gimblet, succeeded in partially penetrating and entangling the point in the substance of the capsule. He then introduced a second needle from the opposite side, and, bringing the penetrating force of one needle to bear upon the

[1] *Handbuch der Augenheilkunde*, 1880, p. 371.

[2] *Royal London Ophthalmic Hospital Reports*, vol. x. p. 145.

other, pierced the tough capsules with both; then by separating one point from the other he succeeded in making a rent in the centre. This was followed by the escape of a small quantity of lens matter of the consistence of cream cheese. The operation gave rise to very slight reaction, and an interval of two months was allowed to elapse, during which the soft lens matter was absorbed and the capsule closed again. The same operation was repeated three times, and at last a small round clear space was obtained. Fair vision was secured.

FIG. 120.

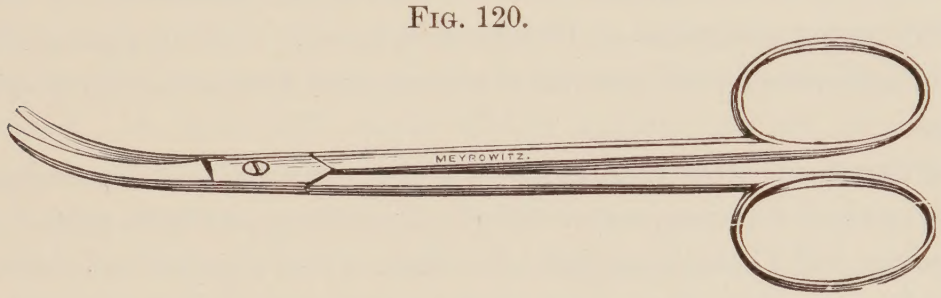


FIG. 121.

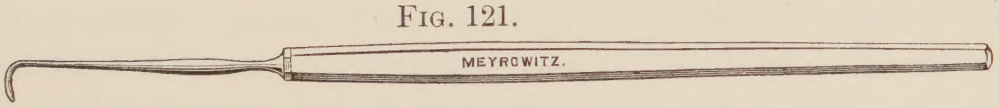


FIG. 122.

FIG. 123.

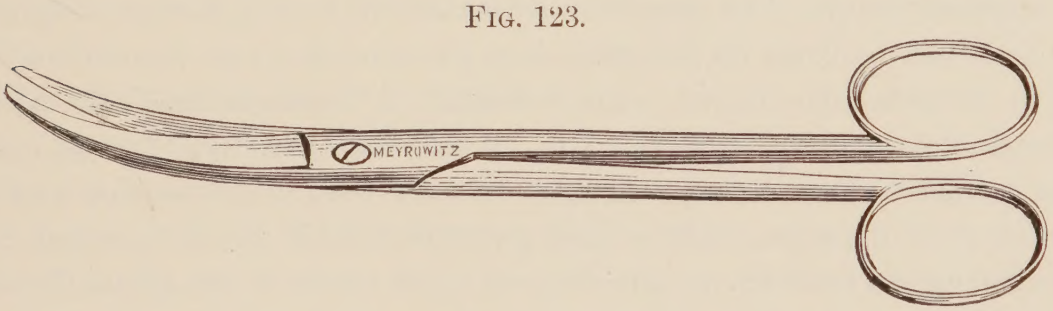
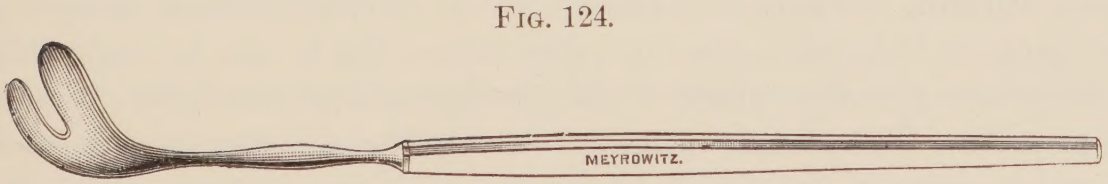


FIG. 124.



Operation for Enucleation of the Globe.—Instruments required: A spring-top speculum (Figs. 105 and 106); a fixation forceps (Fig. 107); a small hooked forceps; strabismus hooks (Figs. 121 and 122); a pair of small blunt-pointed scissors (Fig. 120); a pair of strong blunt-pointed scissors (Fig. 123); a De Weltz spoon (Fig. 124). The ocular conjunctiva is divided all around close to the cornea. Tenon's capsule is next opened and the recti tendons and neighboring fasciæ divided on a hook. The eyeball is then made to start forward by pressing the speculum behind the equator of the globe. The scissors are then introduced and passed backward along the sclerotic till their open blades can be felt to embrace

the optic nerve, which is divided by a single cut, while the globe is steadied with a finger of the other hand. Finish by dividing the oblique muscles and remaining soft parts close to the globe. If the eyeball is ruptured or rupture is imminent, a small De Weltz spoon is passed along the sclerotic and over the optic nerve. This acts as a director to the scissors, with which the optic nerve is now to be cut. The section of the nerve is followed by the rapid detachment of the oblique muscles and of the cellular tissue, which still retains the eyeball. The orbit is cleansed with a solution of bichloride of mercury (1 : 5000) and a compress of bichloride gauze (1 : 1000) placed over the closed lids, covered with sterilized cotton, and fastened with a sterilized bandage.

Operation of Neurectomy.—In the operation of neurectomy we proceed in the following way: After an opening has been made into the conjunctiva and Tenon's capsule at a distance of about three millimetres behind the insertion of the internal rectus muscle, this muscle is laid bare, and two slightly curved, blunt, but knobless strabismus hooks are introduced beneath it. These hooks being drawn into opposite directions, one will be caught in the angle of insertion of the tendon, and tend to roll the eyeball outward, whilst the other will draw the muscle forward out of the orbit. Near the latter hook a catgut thread is passed through muscle and conjunctiva, first from within outward, and then the opposite way. The muscle is now divided at a distance of at least five millimetres from its insertion into the sclerotic, and the ends of the catgut threads are united into a knot. A second thread is passed through the terminal stump of the muscle and similarly bound into a knot. The wound is now extended toward both the superior and the inferior recti muscles, and a small pointed double hook inserted into the sclerotic as far back as possible, in order to draw the globe forward and outward. A pair of scissors curved on the flat are introduced alongside of the globe, and the optic nerve, which can be easily felt, since it is put on the stretch, is cut through as near the optic foramen as possible. The posterior aspect of the globe can now be exposed to view by means of the double hook; the optic-nerve stump remaining on the eyeball is cut off near its insertion into the sclerotic; the insertions of the oblique muscles are divided; and the whole posterior circumference of the sclerotic bared by dissection. Afterward the eyeball is replaced, the wound closed by means of the catgut threads previously introduced, and the lids stitched together by three silk sutures. The last is done as a precaution against the development of sanguineous exophthalmus, which disagreeable complication had best be avoided. There is no more danger of its forming after the lapse of four days, when the stitches can be removed. They usually have cut through by this time, either in the upper or the lower lid.

The operation looks very formidable, the eyeball being almost completely enucleated, and remaining in connection with the recti muscles and the conjunctiva only. Nevertheless, the consequences of the operation are very slight, and scarcely a vestige can be found after healing.

Operation of Evisceration of the Globe (Graefe's).—With a small and sharp scalpel or cataract knife the operator cuts carefully through the conjunctiva and sclera two or three millimetres distant from the corneo-scleral margin, until the dark pigment of the choroid comes into view, when a pair of fine scissors is introduced and the scleral cut completed at the same distance from the cornea and without injuring the choroid. A thin, stiff spoon with a square instead of sharpened edge, and shaped to the form of the bulbus, is then introduced between the sclera and choroid, pushed slowly back to the optic nerve, and the contents of the bulbus *in toto* removed—spooned out. The conjunctiva is then brought together as before by means of a tobacco-pouch suture, or, better, by three common sutures of catgut. The operation is performed under continuous inundation with a solution of corrosive sublimate 1 : 5000. It is of course not always possible to remove *in toto* the contents of the bulbus, as there are often old scars and the choroid adheres to the sclera, in which case the remaining choroid is removed with the scissors or sharp spoon. If the patient complains of severe pain upon coming out of the narcosis, ice compresses are applied for an hour or two.

Mules's Operation of Evisceration.

1. Anæsthetize the patient.

2. Use a hand spray and thoroughly cleanse and disinfect the appendages with 1 : 1000 corrosive sublimate.

3. Transfix and remove the front of the eye with a sharp knife at the corneo-scleral junction ; it is better, I think, not to cut the conjunctiva.

4. Empty the contents of the globe in any way that is convenient, taking special care to remove the ciliary body and choroid, leaving only a clear white sclera.

5. With a thin india-rubber tube, used as a syphon, run the sublimate solution into the eye the whole time the operation is being performed ; as an additional precaution, I use the hand spray also, and continue this till the bleeding ceases or nearly does so.

6. Select the size of glass sphere best suited to the case. Slit the sclera vertically until the glass sphere will with difficulty enter the cavity. Understand, this difficulty only refers to getting the globe *in ;* when inside it should fit so that the sclera unites easily over it, and without leaving any awkward angles.

7. Sew up the sclera along the cut edge with prepared catgut, taking care to obtain good apposition.

8. Spread a layer of finely-powdered iodoform over the whole conjunctiva, and dress with wood wool in a double layer of Lister's gauze.

9. Keep the patient, as a precautionary measure, in bed for three days, and always dress the eye under a spray.

DISEASES OF THE OPTIC NERVE, RETINA, CHOROID, AND VITREOUS; AMBLYOPIA AND AMAUROSIS.

By S. C. AYRES, M. D.

The above title includes a group of diseases of the greatest importance. They require expert use of the ophthalmoscope to detect and differentiate them. They are mostly due to constitutional and systemic disturbances, and the therapy is consequently directed to the general condition. Numerically they do not form a very large percentage of the total number of eye cases treated, but their importance cannot be over-estimated. They are the eye troubles that lead so often to total and permanent blindness.

DISEASES OF THE OPTIC NERVE.

Optic Neuritis.

It is most practicable to consider cases of optic neuritis according to their etiology, for the only possible good resulting from treatment is when this is directed toward the causal factor and this factor itself is amenable to therapeutic agents.

General Treatment.—In all cases of optic neuritis there are, however, some general indications for treatment independent of the systemic causal factor. The local congestion demands early and prompt depletion, systemic and local. This is secured by *catharsis* and bleeding. Even if the bowels be regular, and much more if there be any constipation, it is imperative to deplete by securing copious watery stools. Brunton has shown that with any considerable watery depletion from the intestines the blood-pressure at more remote points is necessarily diminished. These watery stools are secured with least reaction and general depression by 3-drachm doses of sulphate of magnesium, repeated every hour until four, six, or even eight doses have been given. The disagreeable taste is well masked by coffee.

Sufficiently free purgation can then be continued by drinking a bottle of the citrate of magnesia daily, or even oftener if necessary. This drink is not unpleasant; or some of the mineral waters, like Hunyadi or Carlsbad, can be used.

Bleeding is also indicated to relieve the blood-pressure. Although the reaction from the extreme venesection of earlier days has gone to the other extreme, it can hardly be doubted that some cases of optic neuritis would be benefited by this measure. Such cases as are of acute character and with great congestion and swelling of the disc, and where the causal agent is of a transient nature, would certainly be relieved, or at least tided over, and the resulting damage either greatly diminished or even entirely prevented.

Local bloodletting can be employed, secured by *leeches* or the use of the heurteloup (artificial leech). The anastomosis of the facial vein at the inner angle, and of the branches of the lachrymal artery at the outer angle, are free enough to secure considerable deep depletion by leeches applied at these points. Two can be applied at each angle, and allowed to remain until they fill up and drop off satiated. Two more can be put on with advantage in some cases. Care must be taken not to allow them to attach themselves to the conjunctiva or cornea, or very inconvenient bites may result. The neatest way to apply them is to slightly scratch these points until they ooze like the spot for a vaccination, put the leech in a little vial, and place the open mouth upon this site; then they must adhere where desired. As a rule, the puffiness and discoloration of the lids after leeching will not be of any serious moment.

The *heurteloup* can be applied to the temple as near the outer angle of the lids as is practicable. The scarifier of the heurteloup should be placed on the temple and the circular cut made. The glass tube may be allowed to fill up once. It will abstract about two ounces. The actual abstraction of the blood itself is probably of value in relieving the congestion, but undoubtedly the greater value of this method is in the so-called revulsive effect that is obtained; and thus the congestion is relieved by attracting it to some other (neighboring) point.

The use of *atropine* is probably of service in these cases. It acts, if at all, by putting the ciliary muscle at rest. The older name for the ciliary muscle, "tensor choroidiæ," indicates its forward dragging action upon the choroid; but whether any of this tension is transmitted so far back as its attachment around the nerve is problematical. But there is enough possibility of this to warrant the use of atropine. Moreover, the action of any muscle must be accompanied by some determination of blood to the part, and this would further justify its use. The probability that atropine slightly increases the intraocular tension would hardly contraindicate its use.

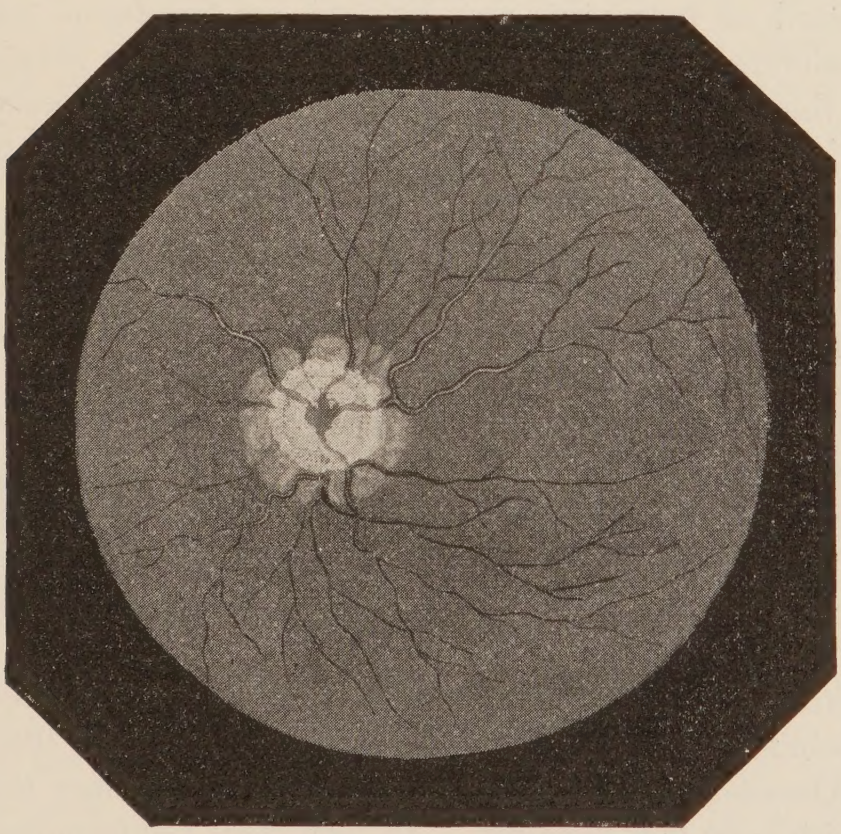
In using atropine or any other alkaloid in the eye it is well to dissolve it in some antiseptic solution. A solution of corrosive sublimate 1 : 20,000, or boric acid 5 grains to the ounce, or a very weak solution of carbolic acid, will answer the purpose. Such a solution used once or twice a day will keep the accommodation at rest in all but exceptional cases among young individuals, when it may be necessary to use it oftener.

Clinical Groups of Optic Neuritis.

Cerebral.—This is by far the largest and most important group of optic-nerve troubles. It is usually bilateral and accompanies all forms of intracranial disease. In the order of frequency it occurs in connection with tumors, meningitis, abscess, and softening. It occurs least frequently in "fine" disease of the brain and in chronic hydrocephalus.

The pathological condition is almost invariably a well-marked neuritis. The nerve is usually greatly swollen and œdematous, with small hæmorrhages as a frequent accompaniment. This form of optic neuritis is the one to which the term "Stauungs-papilla," or "choked

Fig. 125.



Pupillitis with Circumpupillary Exudations.

disk," is almost always so appropriate and descriptive, even if one fails to accept this mechanical theory of its causation.

The theory of Graefe was that this condition is due to increased pressure of fluids in the ventricles; this fluid is driven down the

spaces in the nerve-sheath; on reaching the disk its course is arrested, and the pressure causes it to exude into the nerve-head and produce the swelling and inflammation. Some later observers, as Leber and Deutschmann, have doubted the correctness of this hypothesis, and hold that some morbific influence or the passage downward of some pathogenic element is necessary to the causation of this peripheral symptom. The presence of dropsy of the nerve-sheath in many of these cases that have come under post-mortem examination tends to support the "choked-disk" theory. But the absence of optic neuritis in some intracranial troubles accompanied with greatly-increased pressure (notably hydrocephalus) is strong negative evidence against the theory. It may be said to be still *sub judice.*

In the bulk of these cases the brain trouble is such that nothing can be done.

The plans first given for general therapy may be carried out with some palliative relief of the local symptoms for a time.

The prognosis is generally fatal to vision and, later, to life in most of these cases. This is particularly true of tumors.

In the cases from basilar meningitis the wet or dry cups may be applied to the neck or temple or a seton may be employed. In some cases mustard or turpentine may be used, hot foot-baths may be useful, or moderate venesection may be utilized. Sweating may be induced either by the pack or by the hypodermic injection of pilocarpine or by the Turkish bath (if carefully watched). (For the use of pilocarpine see formula under Detachment of the Retina.)

The view that the neuritis was due to pressure, with distension of the sheath, led to the proposal to tap the sheath and draw off the fluid. For this purpose a hypodermic syringe with a large curved needle was employed. This needle was passed back through the orbit alongside of the eyeball until its point had entered the distended nerve-sheath, and then the syringe was used as an aspirator. The uncertainty of such a procedure probably prevented its receiving a fair trial, for the plan has attracted no attention and received no general support. The marvellous chapter on brain surgery now but being opened to us promises some advances in this section in the future.

Unfortunately, intracranial tumors seem to present absolutely no certain points for localization: neuritis may occur from tumors at any point. Abscesses offer a trifle more hope. Sometimes they may be located with very fair certainty. In such cases the trephine should be used, under strictest antiseptic precautions, and a button of the cranium taken out. A small aspirating needle may then be pushed into the brain-substance with what would formerly have seemed like reckless boldness, and the pus-pocket may be reached. Drainage should be kept up. Some successful cases are reported.

The only intracranial conditions giving rise to neuritis that offer a favorable outcome are the syphilitic. (See under a special group below.) But the bare possibility that any intracranial lesion may be syphilitic should lead to the employment of the iodide of potassium as the first measure in every case where this cause cannot be absolutely excluded.

Outside of such cases vision will be lost in nearly every instance, even when life is not. In cerebro-spinal meningitis useful vision may occasionally be saved. In chronic meningitis blindness usually results, but it is possible for a certain amount of sight to be restored.

Spinal.—Optic neuritis occurs in rare cases of acute spinal disease. Gowers mentions this connection. Probably in nearly all of these cases both the spinal and optic troubles are merely early stages of what will later develop into a disseminated sclerosis. In such cases the general condition would call for its appropriate general treatment. The optic neuritis would demand the treatment we have indicated under the general heading of Therapy, but would probably not be benefited by any local measures. Steffan and Erb, Seguin, Noyes, and Chisholm have lately reported cases of optic neuritis in acute myelitis. These cases have all recovered[1] as regards vision and the spinal trouble. For this reason the appropriate therapy for the spinal affection should be promptly and persistently carried out. In some of these cases this was iodide of potassium. In Noyes' case he gradually increased the amount of iodide to 300 grains daily. The case took four months to recover.

The local treatment already indicated under General Treatment should also be used.

Febrile.—Optic neuritis, or at least œdema or marked hyperæmia of the disk, occurs in a not inconsiderable number of cases of acute infectious diseases. It has been observed in cases of typhus, typhoid, and scarlet fever, in variola, and in rheumatism and malarial poisoning. In typhus, typhoid, scarlatina, and variola the optic neuritis is probably not a direct consequence of the general disease, but is most likely indicative of the development of a meningitis, and is a direct result from this. In rheumatism and malaria the optic neuritis is probably a direct result of this acute general poisoning. Probably in malaria the blood-changes, and in rheumatism the tendency to serous exudation, lead to the œdema or mild neuritis at this point. The former troubles, being self-limited diseases, pass through their course practically uninfluenced by any therapy.

In these conditions it is so very essential to maintain the general strength at the highest point possible that even the measures given under General Therapy are inadmissible here. But, fortunately, the

[1] Except one case reported in the *Annales d'Oculistique*, July–Sept., 1889, p. 123.

course of such a mild neuritis is exceedingly slow, and impairment of the vision is so late coming on that usually the general disease has expended itself before irremediable damage has resulted.

With the tonic treatment in vogue for the convalescent stage of these diseases the optic-nerve trouble receives also the proper treatment. Still, some of these cases result in atrophy and need a course of strychnine and iron.

With the malarial cases quinine is of course indicated. It is best to utilize the first afternoon in giving broken doses of calomel, $\frac{1}{4}$ or $\frac{1}{3}$ grain every hour, until $1\frac{1}{2}$ to 2 grains have been given. On the following day the quinine should be administered. If the malarial attacks are paroxysmal, 10, 15, or 20 grains can be given (according to age and tolerance), in 2- to 5-grain doses, eight, six, and four hours before the attack is expected. This is repeated daily or every other day, according to the character of the manifestations, until the symptoms disappear. It is well then to keep up tonic doses of quinine, 2 or 3 grains three times a day, for a week or more. If the malaria is not distinctly periodic, 15 or 20 grains can be given in 5-grain doses three or four times a day for two, three, or four days, followed by smaller tonic doses for a week. Under this treatment these cases of neuritis rapidly subside and the results are eminently satisfactory.

In the rheumatic cases equally good results are obtained in most cases. The salicylate of sodium should be promptly pushed. It can be given in the average dose of 1 drachm—15 or 20 grains three or four times a day. This is not likely to cause any gastric disturbance. These doses for three or four days will usually cause a subsidence of all acute symptoms, but smaller doses may be advisable for a longer period following. Under this treatment the optic œdema or neuritis disappears usually quite promptly.

It appears to us a reasonable assumption, and one of very great practical value, that a tentative use of quinine and salicylate of sodium in many more cases of optic neuritis than it is ever thought to use them would be followed by beneficial results in many cases which are not now reached.

Syphilitic.—Optic neuritis occurs with considerable frequency in cases of syphilis. In the late or tertiary stages this is probably nearly always due to the development of a gumma at some deeper point, either orbital or along the nerve or intracranial. If not promptly relieved by treatment it leads to subsequent atrophy. In the earlier, more congestive, stages (the "secondary"), where an iritis is so frequently seen, a marked hyperæmia, or even a mild neuritis, is undoubtedly frequently present. Ole Bull[1] holds that it is present in

[1] *The Ophthalmoscope and Lues*, Christiana.

50 per cent. of the cases. This may be excessive, but it is certainly present in a large proportion of cases. Fortunately, this is a transitory condition, and usually disappears under treatment directed to the iritis and the general condition. In these earlier cases the use of atropine is indicated even if iritis be not distinctly present. In these earlier stages the use of mercury is indicated, pushed rapidly to slight systemic effect. For this purpose the unguentum hydrargyri, used in the form of inunction, gives the best and speediest results. The oleate may also be used. A bit of the mercurial ointment about the size of the end of the little finger (the salve is heavy, and this amount will be about a drachm) may be used night and morning. Some point where the skin is tender, as the sides of the chest, inside of arm, inside of thigh, etc., is selected, and the ointment well rubbed in. It is very essential that this be done thoroughly; the rubbing should occupy from twenty minutes to half an hour. These tender spots should be selected in succession, so that a mercurial eczema is not excited at any one point by too frequent application. After the application the area should be covered with a muslin cloth to prevent soiling the bed-clothes or underwear. When the time arrives that firm closure of the teeth gives slight pain in the gums the inunction should be discontinued. Sufficient systemic effect has been obtained, and any further use would only bring on salivation.

Mercury is generally used hypodermically in the form of the bichloride. It produces very rapid systemic effect, but it is painful and occasionally produces abscesses. Its value over inunction is so little, if any, as not to counterbalance these drawbacks. Mercury is used of course by the mouth, the bichloride and protoiodide being the favorite salts. This is no doubt the method most applicable in the long-continued course of treatment that is aimed to effect the radical elimination of the poison from the system, but is not so applicable where the aim is to produce rapid effects. It is well to let this method follow the inunctions. In the late stages, where the optic neuritis is caused by a gumma, it is of paramount importance to bring the system rapidly under the iodide of potassium. For this purpose a standard prescription is the following:

℞. Potassii iodidi, ℥j;
Aquæ dest., f℥vj.—M.
Sig. A tea-spoonful as directed.

This contains 10 grains to the drachm (an ordinary tea-spoonful), and the dosage can be quite conveniently regulated. When the amount has been pushed to a greater daily dosage than this it will be more convenient to prescribe a stronger solution:

℞. Potassii iodidi, ℥ij ;
Aquæ dest., f℥ij.—M.
Sig. From 10 to 60 drops, as directed.

This contains, with sufficient accuracy, a grain to the drop, and can be very conveniently given up to the limit of tolerance. With all these doses water should be taken copiously, to prevent the stomach from reacting against the drug. "Iodism" is frequently produced, but is not necessarily a sign for the cessation of treatment: acne, running at the nose, headache, bad taste, and sore throat are certainly preferable to more or less complete permanent blindness. The remedy should be pushed on, and "tolerance" is soon established. This energetic use of the drug in large quantities is so very necessary because the indirect effects of the gumma are those most to be feared. It is the pressure upon the nerve and other structures that produces damage that is so often not repaired even when the gumma itself has been absorbed. The more rapid the absorption, the less liability to these effects.

For the more complete and exhaustive treatment of syphilis reference is made to the subject of Syphilis in Vol. II.

Toxic.—Under the head of toxic comes an interesting group of cases caused by tobacco and alcohol, by lead- or quinine-poisoning, by nitro-benzol, salicylic and osmic acid. The first mentioned occurs most frequently.

Tobacco and Alcohol.—As tobacco and alcohol are most frequently used together, it is not always an easy matter to separate the effects of the two poisons. It is the opinion of some observers that the amblyopia is due entirely to the alcohol, and not to the tobacco. There are many reports of pure tobacco-poisoning, but probably in the majority of the cases patients suffer from the *combined* effects of alcohol and nicotine.

The symptoms of this disease are a haze more or less dense, and finally a scotoma which occupies the central portion of the field of vision. The field of vision is not limited. There is color scotoma for red and green. In the earlier stages there is a hyperæmia of the disks, and later on an atrophy of the temporal side of the disks. Total blindness does not often result, as the majority of patients apply for assistance before atrophy is very far advanced. Where vision is already seriously impaired and the nerve shows a well-marked atrophy the probabilities are that vision will not be restored although the patient desists from the use of tobacco and alcohol.

One of the first considerations in the treatment is to insist on total abstinence. If the sight is much impaired there can be no middle ground. It is not an easy matter to obtain compliance with this

restriction, as patients imagine themselves worse after they have stopped their accustomed stimulants. A very moderate indulgence in liquor may be allowed in exceptional cases.

A pill of camphor and nux vomica has an excellent effect, and does not give offence to the stomach:

℞. Camphor., gr. xx;
Ext. nucis vomicæ, gr. v.—M.
Ft. in pil. No. xx.
Sig. Take one pill three times a day.

The use of strychnine hypodermically is followed by the most prompt and satisfactory results. The sulphate is generally used. The amount injected must be regulated according to the stage of the disease and the tolerance of the patient for the drug. Beginning with $\frac{1}{20}$ grain, we can rapidly increase the dose to $\frac{1}{10}$ and even more. Cases are on record where $\frac{1}{4}$ grain was used hypodermically without injurious results. Smokers and drinkers will be found very tolerant of the effects of strychnine, and we can safely begin with a full dose. It is desirable to get the constitutional effects of the nervine as soon as possible, and on this account the larger doses are preferable. Strychnine may be given by the mouth in the same doses which are administered hypodermically, or both methods may be combined. Pills of phosphide of zinc and nux vomica may be substituted:

℞. Zinc. phosphid., gr. $\frac{1}{10}$;
Ext. nucis vomicæ, gr. $\frac{1}{4}$.—M.

Turkish baths have an excellent effect, and should be taken every two or three days. A warm bath every night before retiring should be taken where Turkish baths cannot be had. The eyes should be protected from the bright sun and artificial light by slightly tinted blue or smoked glasses. An abundance of sleep, nutritious food, and freedom from business cares will aid in the recovery.

Mr. Jonathan Hutchinson, Jr., orders—

℞. Tinct. ferri chloridi,
Tinct. nucis vomicæ, āā. ♏x.—M.
Sig. To be taken three times a day.

Tobacco is forbidden.

Dr. Minor of Memphis[1] says that tobacco causes functional disturbance only of the optic nerve, while alcohol causes organic changes

[1] *Am. Journ. Oph.*, 1886.

not only in the eye, but in the other tissues. He treats the amblyopia which is associated with drinking and smoking with iodide of potassium.

Bergmeister of Vienna considers that alcoholic amblyopia has the character of an optic-nerve lesion, and from the works of Damelson, Ulthoff, and others he concludes that the lesion is a retrobulbar axial neuritis, seated chiefly at the optic foramen, where the muscular fibres lie centrally. As to prognosis in toxic amblyopia from alcohol and tobacco, he considers it favorable. For treatment he recommends abstinence from tobacco and alcohol, Carlsbad salts, hydropathy, and strychnine injection.

LEAD-POISONING.—Lead-poisoning is associated with a neuritis of a mild or severe type, depending upon circumstances. In mild cases the swelling may subside and the vision be restored. In severe cases there is a consecutive atrophy which may entirely obliterate vision. The history of the case, showing exposure to the influences of lead and the concomitant symptoms, will aid in confirming the ophthalmoscopic diagnosis. Atrophy of the optic nerve is frequently detected when the patient is first examined, but it seems probable that this condition was preceded by a neuritis. Both eyes are usually involved, although one may be attacked in advance of the other.

Iodide of potassium more than any other drug assists in eliminating the lead from the system by the kidneys, and its use should be persevered in until no traces of lead can be detected in the urine. It can be given in 15- to 20-grain doses dissolved in water, taken three or four times daily. It is better taken before meals.

Saline purgatives (sulphate of sodium and magnesium) can be administered with advantage, particularly in persons not broken down by the constitutional effects of the lead-poisoning.

Strychnine hypodermically is advisable, and can be used in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain.

Electricity for the general muscular system produces valuable results in this disease, and its use should be continued during the administration of the iodide of potassium. The interrupted current is preferable to the constant current. Turkish baths followed by friction of the skin are recommended. Massage produces good results in stimulating muscular action.

Schroeder recommends mercurial inunction and potassium-iodide treatment, energetically applied, in all cases of marked neuro-retinitis, from the fact that such a condition untreated leads rapidly to atrophy, in which little can be done. A heurteloup was applied with advantage in one case. Hirschberg accomplished a cure in a very short time by the use of pilocarpine.

QUININE-POISONING.—Large doses of quinine are known to pro-

duce a profound effect on the optic nerve, and cause not only temporary but permanent impairment of vision. There is probably in some an idiosyncrasy for the drug, so that a small dose more readily excites toxic results. The hearing is very frequently affected by the use of quinine even in moderate doses. The toxic influences of quinine on the eye are seen very soon after the drug is taken. There are no evidences of inflammatory changes in the optic nerve, but rather an ischæmic condition. There is dense scotoma, which in favorable cases clears away in a few days from the centre toward the periphery, but it may continue much longer in severe cases.

The amount of quinine which will produce poisonous effects differs in different individuals. Dr. Gruenning[1] reports the case of a lady of fifty years who, after one 30-grain dose of quinine, was deaf for twelve and blind for twenty-four hours. Five days later central vision and color perception were restored, but the field of vision was contracted to about thirty degrees in all directions.

Hypodermic injections of strychnine have been followed by excellent results in cases of quinine-poisoning. Doses of $\frac{1}{20}$ to $\frac{1}{12}$ grain can be used. Iodide of potassium in liberal doses, 15 to 30 grains three times a day, is recommended. It should be given well diluted with water. Nitrite of amyl has been used with good results. Pilocarpine hypodermically ($\frac{1}{12}$ to $\frac{1}{6}$ grain) has produced favorable effects. Leeches to the temple should be tried when the physical prostration of the patient does not contraindicate their use. Brandy and ammonia may be indicated when there is much prostration, and especially in the early stages when the skin is cold and clammy. The patient should be as free as possible from all external sources of irritation and disturbance. There is a natural tendency to recover in all cases not too profoundly affected by the drug.

Nitro-benzol Poisoning—Wieden reports a case of amblyopia with contraction of the visual field, occurring in a man of twenty-six engaged in the manufacture of the explosive known as nitro-benzol. He had general toxic symptoms with cyanosis of face and mucous membrane of lips, labored breathing, irregular, thready pulse, forty-eight per minute. There was marked venous hyperæmia of the retina and papillæ. On the right disk was a patch of exudation. He ceased work and was ordered cardiac tonics.

Cases are also reported of poisoning from salicylic and osmic acids. In such cases the same treatment as for lead-poisoning is advisable.

Anæmia.—In cases of profound anæmia optic neuritis is liable to occur. This has been noted in the anæmia of chlorotic girls in cases of *pernicious* anæmia, and has been frequently noted in cases of anæmia immediately following excessive hæmorrhages of any sort.

[1] *American Oph. Soc.*, 1887.

Menstrual Disturbance.—In many cases of menstrual disturbance, either amenorrhœic, dysmenorrhœic, or metrorrhagic, there is a liability toward the development of optic hyperæmia or optic neuritis. A very mild optic neuritis seems to be the usual rule in the cases affected.

Albuminuria.—Optic neuritis (not associated with the retinitis) has been observed in a very few cases as due to albuminuria. Optic neuritis is also a practically constant feature in the cases of albuminuric retinitis. For this reason it is best to refer its therapy to the section on Albuminuric Retinitis.

Sympathetic.—According to the researches of Leber, Deutschmann, and others, sympathetic ophthalmia is caused by propagation of pathogenic organisms along the sheaths of the two nerves. The onset of the disease, then, in the second eye is the development of a neuritis. In some cases examined early this neuritis can be seen with the ophthalmoscope. It is not always our good fortune to examine the sympathizing eye before it becomes so cloudy that inspection of the fundus is impossible. Could we do so we would probably be able to detect a neuritis in many cases. Where the iris and ciliary are involved the media become so turbid that the retina cannot be seen. When the optic nerve is the seat of the first manifestations of the sympathetic influence we are able to detect the neuritis with the ophthalmoscope.

In a case which I reported[1] there was a well-marked sympathetic neuritis. The injury had been received two months previously. The media of the sympathizing eye were clear, so that the neuritis could be distinctly seen. Vision was reduced to 0.3. There was also a well-marked neuritis of the injured eye, which was enucleated.

In severe injuries of the eye, of whatever kind, the manifestations of sympathetic irritation are quite sufficient to warn us that more serious symptoms are likely to develop, and that prompt measures must be resorted to to prevent the much dreaded serous iritis and iridocyclitis. Many such cases are seen where there is only an undue sensitiveness to light, and where the optic disk does not show even a hyperæmic condition, and yet where, from the character and extent of the injury, it is advisable to enucleate the injured organ. This is the only safe method where sympathetic inflammation threatens. In the great majority of cases enucleation prevents the transmission of the disease to the fellow-eye. It depends, however, on certain conditions not thoroughly known to us yet. Sympathetic inflammation has followed what appeared to be timely enucleation in many well-authenticated cases. The rule, however, will hold good that enucleation is the safest and most reliable treatment when there is threatened sympathetic inflammation. When, however, sympathetic serous iritis or iridocyclitis has fully set in,

[1] *American Journal of Oph.*, Feb., 1887.

we will have to deviate from this rule to meet the circumstances of the case.

Many efforts have been made to save the offending eye on cosmetic grounds. The first plan was an optic neurotomy, but experience showed that this was not an absolute safeguard against sympathetic ophthalmia. Then a neurotomy of the ciliary nerves was tried, but this was soon shown to be useless. Then both were cut, the ordinary optic-ciliary neurotomy, and by some even a section was removed, making it a neurectomy. But a few cases were slowly put upon record where even these precautions failed in preventing the sympathetic trouble, and these plans have been generally abandoned.

Lately, efforts have been made to save the shell of the eyeball of the exciting eye. This is really also upon cosmetic grounds alone, for its only object is to secure a stump better adapted to move the artificial eye in a natural and free manner. The one plan is that of exenteration, proposed by Graefe of Halle. Here the cornea is first ablated by a broad spear knife; then the contents of the globe, uveal tract, retina, lens, and vitreous are scraped out by an aseptic spoon; the cavity is irrigated by an antiseptic lotion and the opening is drawn together by a "tobacco-pouch" suture. A further modification is that of Mules of Manchester, who inserts a small hollow glass sphere in this emptied cavity of the vitreous, draws together the opening in front, and thus attempts to have this sphere encapsulated. The strong objections to these plans are the severe reaction and the longer term of recovery. But should they prove equally effective they offer a great advantage in a better stump.

Orbital.—There are some cases of optic neuritis due directly to the presence of inflammatory conditions in the orbit. These are seen in cases of orbital cellulitis, abscess of the orbit, erysipelas extending into the orbit, etc. Some cases of rapidly growing neoplasms in the orbit are accompanied with a neuritis; this seems to be almost constant in the cases of gummata of the orbit.

Optic Neuritis from Aural Disease.—Attention has been called in more recent years to a condition of hyperæmia of the disk, or even mild optic neuritis, associated with disease of the middle ear, the ocular trouble occurring on the same side as the aural. It is probably dependent upon an intense congestion of the contiguous meninges. This is probably either caused or aided by a condition of obstruction in the ear.

Refractive.—In many cases of refractive trouble, especially those that are associated with accommodative strain, like hypermetropia and hypermetropic astigmatism, the optic disk is seen to present not a condition of actual neuritis, but a well-marked hyperæmia. This is a result of the combined influence probably of the general

congestion and the ever-present drag upon the choroid by the ciliary muscle.

Rest of the eyes, protection by tinted glasses, and atropine should be the treatment. The eyes should be placed under the influence of homatropine, and the refraction carefully tested and correcting lenses ordered. The use of the eyes, even with glasses, should be restricted for a while. The choroid suffers more from refractive errors than the optic nerve or retina. This is particularly the case in malignant myopia, which will be considered under the head of Choroidal Affections.

Iodiopathic.—There are a few cases of optic neuritis which seem to arise spontaneously and without any apparent causal factor. Simple exposure to cold or some undefined general condition seems all that is necessary in some cases. But as our knowledge widens such cases diminish in number and frequency. The treatment of such cases would follow necessarily the rules laid down under the heading of General Treatment above.

Optic-nerve Atrophy.

Cases of optic atrophy can also be grouped under headings indicative of the primary cause, and this whether the cases be "simple" or "primary," or whether they be "secondary," consecutive to neuritis.

Congenital and Hereditary.—In some cases atrophy is found to have been present probably at birth. This congenital condition is due no doubt to some intra-uterine disturbance. In some extremely interesting cases, reported by Leber, Fuchs, Nettleship, and others, an optic atrophy occurs as an hereditary affection in certain families. In these children the optic atrophy, "simple" in character, develops slowly, coming on sometimes during youth or early adult life. In all this group any therapy seems out of the question. The condition is either completed and fixed or its onset seems to be uncontrollable by any known means at our command.

Treatment is practically unsuccessful. Mercury, iodide of potassium, diaphoresis, local bloodletting, nitrate of silver, strychnine, and galvanism of the sympathetic have all been tried without distinct benefit.

Graefe saw marked improvement from sweating, and Mooren recommends nitrate of silver internally and setons in the back of the neck.

Dr. Norris says that strychnine improves peripheral vision—that "its effects are not due to any specific action on the nervous system, but to the fact that it increases arterial pressure, so as to drive a greater part of the blood into the shrunken capillary vessels of the optic nerve and retina, and thus restores proper nutriment to tissues which have been to a greater or less degree in a state of starvation." Cases are reported where the mother and one child had atrophy, but

where there was no inherited predisposition to nervous troubles on the part of the mother. Again, in a family one or two of the children may have atrophy, while the balance of the family have good eyes. In one family which came under the writer's observation, where the parents were healthy and strong, there were two children with optic-nerve atrophy. The elder son was somewhat hydrocephalic, and this may be assigned as the remote cause of the eye complication. Two years later a younger brother had beginning atrophy of both eyes. He could not see well on the blackboard, and was sent home by his teacher with instructions to get glasses. Upon examination both disks were found pale and vision slightly reduced in the right eye, but considerably reduced in the left. I used strychnine hypodermically and potassium iodide internally, and the right eye was restored to perfect vision and the left eye much improved. In this son there was no hydrocephalus to account for the lesion.

Cerebral.—These are the cases that are consecutive to the neuritis of cerebral origin. They have the character that has been noted under the description of "secondary" atrophy. Although neuritis of cerebral origin is one of the most common among the forms of optic neuritis, this form of atrophy is very infrequent, from the fact that so many of the cases end fatally before the atrophic stage sets in.

Spinal.—This is the largest and most important group of the cases of optic atrophy. It presents the most characteristic example of "simple" atrophy. It occurs in connection with the cases of spinal sclerosis. These two outposts of the brain (histologically identical) seem to be involved in a common process.

General.—These are the examples of optic atrophy which are consequent upon the œdema or neuritis described in our groups of febrile, syphilitic, and anæmic neuritis. When the condition has already passed from the stage of neuritis to the retrograde stage of atrophy, therapy directed to the general condition is of secondary import, and treatment must be directed toward checking the regressive changes in the nerve.

Toxic.—Toxic cases include atrophy from lead-poisoning, from tobacco- or alcohol-poisoning, and from quinine-poisoning.

Orbital.—These are the cases due to neoplasm in the orbit, to abscesses of the orbit, and to exophthalmus from any cause. The active factor in their production is the pressure or tension upon the nerve. They are usually "simple" in character, although their onset may have been marked by decided hyperæmia, œdema, or mild neuritis.

Traumatic.—Cases of atrophy from trauma are "simple" in character. They are due to pressure or to solution of continuity of the nerve. The atrophy is caused by foreign bodies, of which bullets are the most frequent probably, which, penetrating the orbit,

either sever or press upon the nerve. The disease is also frequently caused by fractures of the cranium. The splintering, either frontal or basal, runs along the orbital plate of the frontal or along the wing of the sphenoid, and the displaced portions press upon the nerve in or about the optic foramen.

DISEASES OF THE RETINA.

The retina is the expansion over the fundus of the eyeball of the nervous elements of the optic nerve. The bare axis-cylinders pass over into the inner layer of the structure, and become reinforced, as it were, by certain ganglionic and nuclear elements, the rods and cones. These nervous elements are held together by a connective-tissue framework, the fibres of Mueller. The whole structure is supplied by the capillaries of the arteria centralis retinæ.

The diseased conditions of the retina are to be grouped under the following heads:

Anæmia.—Here there is a narrowing of the capillaries and a diminished blood-supply.

Hyperæmia.—This is the opposite condition, an enlargement of the capillaries, or even an increase of their number, and a greatly increased blood-supply.

These two conditions, unless extreme, are difficult to estimate accurately by the ophthalmoscope, owing to the wide normal variation in the blood-supply and resulting tint of the retina.

Œdema.—Here there is a serous infiltration into the tissues of the retina. By the ophthalmoscope this is recognized as a blurring of the fine details and by a clouding or grayish tint given to the retina.

Fatty Degeneration.—This fatty or sclerotic change is marked by hypertrophy of the connective-tissue elements, by swelling or knob-like enlargements of the nerve-fibres, and by the pressure of fat-globules. The change is most marked in albuminuric retinitis.

Purulent.—This presents a purulent infiltration of the retina, and is of course accompanied by a rapid degeneration of all its structures. It is characteristic of septic disease or panophthalmitis.

Diffuse Atrophic.—In this form there is an atrophic degeneration of the retinal structures. It is best marked in detachment of the retina and in old cases of embolus.

Clinical Groups of Retinitis.

The ophthalmoscopic groups of retinitis and the clinical groupings are fortunately practically identical. The various forms are due to

numerous systemic or remote causes, and the therapy can only be directed, as a rule, to these causal conditions.

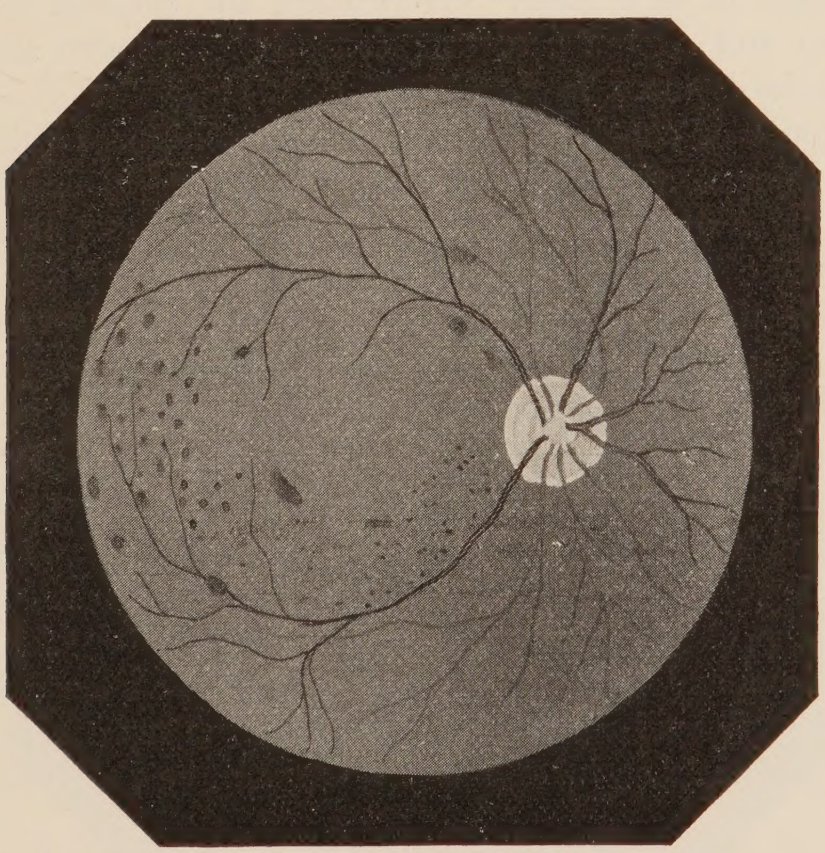
Ischæmia of the Retina.—Ischæmia of the retina is characterized by blanching of the disk, narrowing of the lumen of the arteries, and temporary total loss of vision. It may be due to toxic influences, as excessive doses of quinine, but it also results from physical exhaustion combined with mental anxiety, congestive chills, whooping cough, and erysipelas.

Treatment must be directed to the general condition: nearly always this will consist of tonic treatment by quinine and iron, with sustaining treatment by stimulants and cod-liver oil.

Leukæmic Retinitis is a disease which accompanies an abnormal increase in the proportion of the white to the red corpuscles of the blood. It is an obscure disease and rarely seen. It is dependent upon a diseased condition of the spleen, the bone-marrow, or the lymph-glands. These organs are more frequently involved conjointly than separately.

Dr. Bull, in Wells' work on the eye, says in a note that in progressive pernicious anæmia the retina is apt to be the seat of hæmorrhages

FIG. 126.



Retinal Hæmorrhages.

with more or less pronounced inflammation. In this disease there is a diminution or destruction of the red blood-corpuscles, which is no doubt intimately connected with the hæmorrhages. The hæmorrhages

are always extensive, and the fundus resembles that found in leukæmia and diabetes.

Gowers says "that in cases of leucocythæmia the retinal and choroidal vessels are remarkably pale. The tint of the choroid is usually an orange-yellow, but if there is much choroidal pigment the tint may be a little changed."

Retinitis in Hæmophilia.—Hirschberg reports a case of a young man of hæmophilic diathesis who had a well-marked retinitis. There were small hæmorrhages on the optic papillæ and along the course of the veins, and numerous small roundish specks of blood at the periphery of the retina.

The *treatment* of retinitis due to anæmia has for its first object the restoration of the blood to its normal condition. The means used to bring this about are dietetic, hygienic, and therapeutic. The best of easily-digested and nutritious food should be supplied in quantities not to offend the stomach. Milk and cream are most valuable articles of diet if they are well borne. The quantity taken is to be limited only by the ability of the patient to digest it without discomfort. Eggs, broths, soups, and meats carefully done, vegetables well cooked, form articles of diet which should be very carefully regulated as to quantity taken at each meal. Overloading the stomach is an unfortunate thing and retards progress; better take a smaller amount each time and take it more frequently.

An amount of out-door exercise, either walking or riding, which does not exhaust should be taken. A change of locality to the mountains or sea-shore or to the South, where out-door exercise is possible, will often aid in bringing about the desired result.

Of the therapeutic remedies used, iron justly enjoys an enviable reputation. It is dispensed in numerous forms more or less attractive. Ferrum redactum is administered in the form of powder, pill, or troche. It is also prepared for children in chocolate creams. It can be given in dose of 1 or 2 grains taken after each meal. Carbonate of iron in 3-grain doses, bromide of iron in 5- to 20-grain doses, and the lactate of iron in 5-grain doses, are valuable remedies. The citrate of iron (5 grains), the citrate of iron and strychnine (1 to 3 grains), and the citrate of iron and quinine (5 to 10 grains) have long held their places as justly popular preparations of iron. They can be taken in powder or pill form or in capsules, or they can be dissolved in sherry wine.

The tincture ferri chloridi and the syrupus ferri iodidi are among the most valuable preparations of iron. The former is particularly indicated where a diuretic effect is desired, and the latter where the glandular system is involved. They are used in doses of 5 to 15 drops in water, taken after each meal. Large doses of iron dis-

turb the stomach and excite headache, and should be avoided. Mr. Eales recommends ferri sulphas and liquor ferri perchloridi internally three times a day, and liberal but light diet: for dinner, meat, minced, pounded, and warmed, but not cooked.

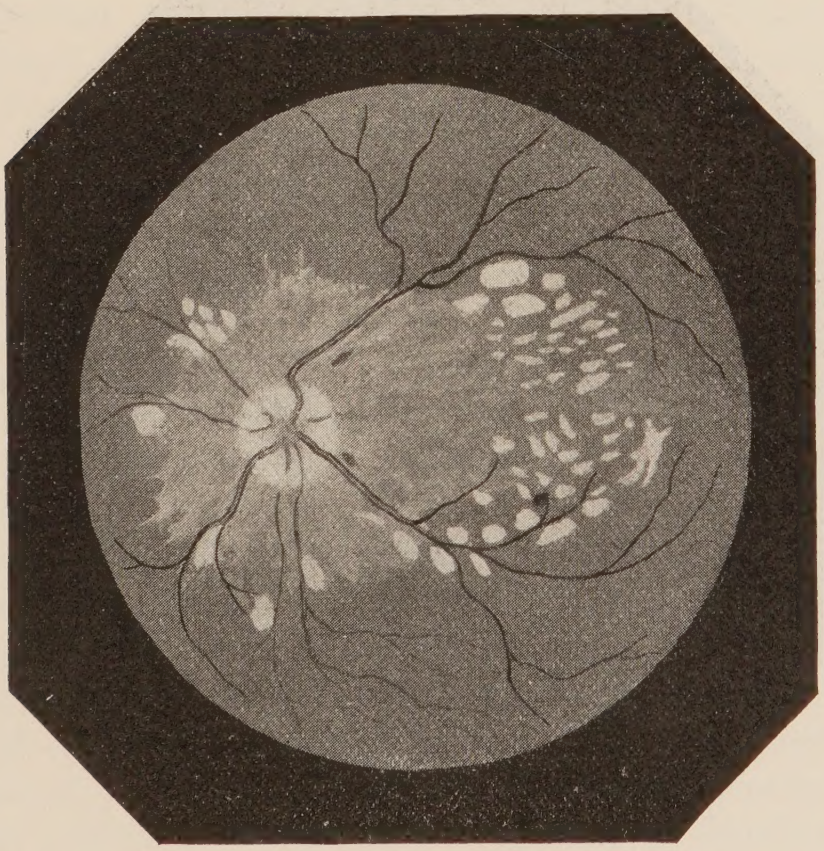
Mosler recommends piperin and oil of eucalyptus, as follows:

℞. Olei eucalypti,		gtt. c;
Piperini,		
Ceræ albæ,	*āā.*	ʒj;
Pulv. altheæ,		ʒij.—M.
Ft. in pil No. c.		
Sig. Three to five pills three times a day.		

He also had good results from the long-continued use of quinine, 5 to 8 grains or more each day. He advises arsenic in large doses.

Albuminuric Retinitis.—Retinitis albuminurica is a degeneration of the retina occurring most frequently in the chronic forms of renal disease, particularly in those varieties known as granular, small, white, and contracted kidney. It comes on during pregnancy, and also in the course of an attack of scarlet fever or diphtheria. The retinal alterations are due to a fatty degeneration of its fibrous tissue, and are

FIG. 127.

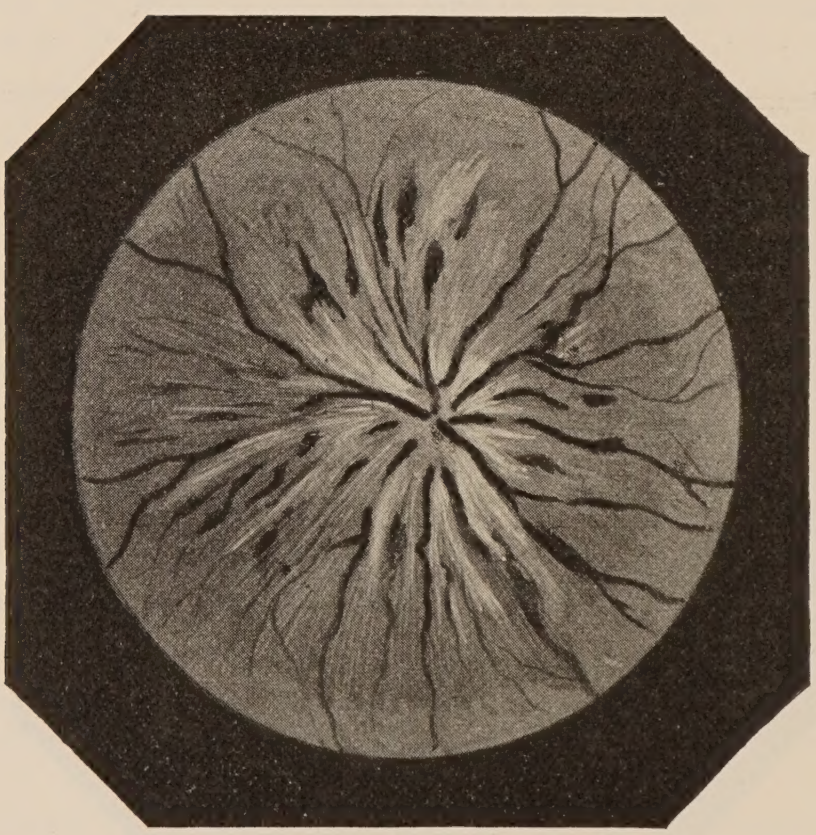


Retinitis Albuminurica.

more or less pronounced in different cases, and especially localized in the radiating fibres of the retina around the region of the yellow spot.

The presence of albumin in the urine is not always evidence of a true nephritis or Bright's disease, as it may be due to some digestive or assimilative disturbance. When, however, there are other accompanying symptoms, we may decide that we have a case of organic disease of the kidney to deal with. In the course of Bright's disease the urine varies in quantity. Diminution in the quantity of urine voided is usually followed by certain well-marked cerebral symptoms, as headache, neuralgia, general uneasiness, nausea and vomiting, slight or severe delirium, and later on stupor and convulsions, contraction of the muscles, and finally coma. The ophthalmoscopic picture which a case of retinitis albuminurica presents is striking and characteristic, and can be easily recognized. It is so typical that a diagnosis may almost be made from this alone. There is swelling of the optic papillæ and obscuration of the larger vessels of the disk. The central portion of the retina is obscured by white patches or plaques, which are characteristic of the disease. They have a bright, shining appearance, and in many cases arrange themselves in a somewhat regular stellate appearance around the macula. In addition to these striæ there are small dots and large splotches. Frequently the stellate appearance is not marked, and instead there are irregularly shaped plaques scattered

FIG. 128.



Neuro-retinitis Apoplectica.

around the macula and extending some distance out toward the equator of the globe. Retinal hæmorrhages are frequently seen scattered about between the white patches. The optic nerve participates more or less

in the inflammation, and presents swollen and elevated edges with occasionally small hæmorrhages. The vision is impaired to a greater or less degree, depending upon how seriously the macula and optic nerve are involved. In favorable cases the white spots around the former are absorbed, and disappear or partially remain, but with restoration of vision. In other cases a patch of atrophy marks the macular region and central vision is destroyed.

The most serious results follow when there is a deep involvement of the optic nerve. The swelling of the disk subsides, and then atrophy of the optic nerve follows, which may be so profound as to destroy sight entirely.

The renal symptoms frequently do not attract attention nor excite alarm; in fact, the patient may not be aware that he has renal disease until this is demonstrated by the examination of his eyes with the ophthalmoscope. This is an evidence of the insidious manner in which the disease advances in some cases. In the majority of cases, however, other pathological symptoms characteristic of the disease have attracted the patient's attention, as, for instance, dropsy more or less pronounced, heart symptoms indicative of secondary hypertrophy of the left ventricle, scantiness of the urine, and some of the different phases of uræmic poisoning. Statistics from various observers show that the involvement of the optic nerve and retina occurs in from 20 to 33 per cent. of all cases of albuminuria. The time at which the retinal changes occur varies in different cases. The examination of a large number of cases would probably show that it develops earlier and more frequently than is generally supposed. It occurs as early as the third month in pregnancy, and in scarlet fever is found during the acute stage. The inflammation more frequently involves the central portion of the retina, and sometimes to the exclusion of the optic nerve. Again, this is reversed and the optic nerve is more inflamed, with slight retinal alterations. But more frequently both nerve and retina participate in the inflammation.

Albuminuric retinitis is an accompaniment of pregnancy, and may occur early as well as late during the course. In mild cases the white patches on the retina may be nearly all absorbed after delivery, and in some they disappear entirely. In such cases good vision is preserved. In many, however, the issue is not so favorable, and the unfortunate patients suffer permanent impairment of vision, if not total loss. There is in some a dense central scotoma, with preservation of enough peripheral vision to enable them to go around comfortably; in others atrophy of the optic nerve destroys the sight entirely. The presence of retinal changes increases the gravity of the prognosis, as they indicate a high degree of blood-poisoning. In puerperal albuminuria the double duty of excreting the effete matter

of mother and fœtus overloads the blood with excrementitious matter, increases arterial tension, irritates the kidney, and is liable to be followed by these retinal changes.

With parturition the cause alike of the albuminuria and increased tension is removed. Cases of albuminuric retinitis when this high arterial tension is combated by rest in bed, calomel, and salines frequently show improvement in vision before any changes can have possibly taken place in the organic lesions. This result is probably due to the relief of the obstructed circulation and consequent better nutrition of the retina.

TREATMENT.—The indications for treatment of the renal trouble are as follows:

Acute Forms—(*a*) Rest in bed; (*b*) wash out the renal tubes and remove retained excreta by dry cupping, hot baths, lithia-water, infusion of digitalis, cathartics; (*c*) restore the kidneys to a better condition by muriate of iron, flannel pads over the loins, milk diet with not too much solid food; forbid strong coffee and alcohol.

Chronic Forms—(*a*) Improvement of the general condition by iron, quinine, and cod-liver oil, milk and light farinaceous diet; (*b*) prevention of acute attacks by careful living, avoidance of cold and fatigue, warm dressing, but not sufficient to cause perspiration, keeping the feet dry, and giving small doses of mercury; (*c*) treatment of symptoms by diuretics when urine becomes scant, cathartics and hot baths should uræmia occur.

Jaborandi is given in the fluid extract in doses of $\frac{1}{2}$ drachm to 1 drachm. It is best given in the morning about two hours after breakfast. It can be administered in a cup of weak hot tea without sugar. The patient should undress and go to bed, and place a pair of blankets over him. If the first dose does not act on the skin in twenty minutes, a smaller dose (half the amount first taken) should be given. After the sweating has begun the patient should lie quietly in bed until the skin ceases to act; then he should rise and be thoroughly rubbed with dry rough towels before dressing. Pilocarpine may be used in $\frac{1}{4}$-grain doses hypodermically.

The wet pack, which may be employed, is carried out as follows: A thin blanket is wrung out of water, and the patient, divested of all clothing, is wrapped in it from chin to feet. Then a dry blanket is wrapped around him and loosely covered with a mackintosh. After an hour or so the wet pack is removed and the patient swathed in a dry blanket.

In cases occurring during pregnancy Loring and others discuss the propriety of bringing on premature delivery in order to save the mother from impending blindness. In not a few cases it is not only justifiable, but the true principles of sound practice demand its adop-

tion. Cases of retinitis albuminurica in pregnant women are reported in which premature delivery was resorted to with the best effects to the mother's vision. Howe concludes "that the induction of labor is warrantable when the retinitis appears in a comparatively early stage of pregnancy and persists in spite of proper treatment, but is not warrantable in the last few weeks, in spite of the greater ease with which it is accomplished, unless the inflammation is unusually severe."

Diabetic Retinitis.—Diabetic diseases of the fundus are much less frequently met with than those due to albuminuria. The ophthalmoscopic pictures which the two diseases present resemble each other very much. Dr. Noyes says that "in diabetes hæmorrhages are more frequent and abundant than in retinitis albuminurica." The white patches are not so numerous or so large, and do not so generally arrange themselves in stellate form as they do in renal disease. The fact that albuminuria and diabetes are found at times in the same person may account in some cases for the resemblance in the retinal changes. Diabetic retinitis more frequently appears in the later stages of the disease, and is associated with other severe constitutional disturbances. Hæmorrhages into the vitreous are characteristic of this disease, and are liable to recur. Cases are recorded where atrophy of the optic nerve or glaucoma follows this disease.

The character and quantity of the urine will guide us in differentiating between this disease and nephritic retinitis. The prognosis for sight (as well as for life itself) is, as a rule, very unfavorable. This is doubtless due to the fact that the retinitis usually shows itself in the later stages of the disease, when the system is undermined by the progress of the systemic disease.

Diabetes is associated with excessive thirst, loss of flesh, saccharine urine, and general disturbance of health. In true diabetes the skin is harsh and dry, the muscles become soft and flabby, there are languor and lassitude and inability to take exercise; the digestive system becomes deranged, so that food is not assimilated. The bowels become constipated; the mucous membranes of the mouth and throat become dry and present a reddish appearance. The urine is secreted in immense quantities, the amount varying from 10 to 25 pints per day in severe cases. The amount of sugar eliminated is very great in some cases, and has been known to be as high as 1 or 2 pounds per day. Purdy says that ocular symptoms occur in about 20 per cent. of all cases of diabetes. (This probably includes cataract and all other lesions, as retinal changes have not been observed in such large proportions.)

The prognosis is more favorable for those in advanced years than for the young, as statistics show that the latter usually succumb to the disease very quickly. As the ocular symptoms are only symp-

tomatic, there is no special course of eye treatment except in cataract and glaucoma.

The *treatment* of diabetes must be principally systemic and dietetic. Many remedies have been tried, and some have proved very servicable in controlling and even apparently curing the disease, but this has only been with the aid of strict diabetic diet. Drugs are second in importance to properly selected foods and drinks. Purdy states the question very aptly and concisely when he says that "our chief resource against the disease must consist in withholding from the system that which it is capable of converting into sugar, and in supplying that which it is capable of assimilating as nourishment."

Opium seems to hold the first place as a remedy in this disease.

For the treatment by opium, codeine, carbolic, lactic, and salicylic acids, alkalines, antipyrine, glycerin, ergot, milk, and many other remedies, and for the diet for diabetes, the reader is referred to the article on Diabetes in Vol. I.

Spasm of the Retinal Arteries.—Alteration in the retinal circulation due to vaso-motor irritation may cause attacks of temporary blindness in one or both eyes which last from a few minutes to half an hour or longer. The attacks pass off almost as quickly as they came on. The cloud lifts and the visual field is clear again; no ill effects remain and no traces in the retina. The causes must be sought in the general physical condition.

If this condition arises from overwork or anxiety, rest and tonics are indicated. Among the latter nux vomica and quinine are most efficient.

Flimmer Scotoma.—Persons suffering from migraine have somewhat similar attacks, but they begin in a different manner. There is first a bright glimmering off to the right or left, as the case may be. A bright zigzag light appears which resembles lightning. It has a rapid movement, which increases until it produces a most unpleasant cerebral sensation. It increases in length and brilliancy until the characteristic fortification appearance is present, after which it slowly disappears. At its height there is usually a more or less complete hemianopsia. The attack seems to indicate alteration in the cerebral circulation. The remote causes may be mental or physical exhaustion, indiscretion in eating and drinking, dyspepsia, constipation, or some uterine disease.

Pressure on the carotid arteries for a short time will break up or modify the attack. Inhalation of 3 or 4 drops of nitrite of amyl will accomplish the same end. In these patients, if more rest and leisure cannot be secured, it is very important that a tonic course of iron, quinine, strychnine, or cod-liver oil be carried out in the intervals between the attacks, to prolong these intervals, and if possible to prevent further attacks.

Embolism and Thrombosis of the Retinal Vessels.—Embolism of the central artery of the retina is characterized by sudden blindness and by peculiar and striking ophthalmoscopic changes in the fundus. When the plug becomes firmly lodged in the artery all circulation in the retina is cut off, and it becomes opaque and œdematous. This œdema of the retina comes on in many cases very promptly, but in others it does not appear for a day or two. The area involved is sometimes very broad, extending far out toward the equator, but generally there is a milky opaline circle around the disk and also around the macula. The latter appears as a cherry-red spot in the centre of its opaque surroundings. The arteries are diminished in calibre and appear thin and thready. The veins show corresponding alterations, but appear larger toward the periphery. In rare cases a single branch of the artery is affected.

Nettleship reports a case of "embolism or thrombosis" of *both* central arteries, the second one occurring twelve days after the first. In thrombosis of the retinal vein the œdema of the retina may be about the same as when the artery is obstructed, but there is a marked difference in the appearance of the arteries. They are but slightly altered in calibre. In thrombosis small hæmorrhages around the disk are frequently seen. The œdema of the retina continues for several days, and then slowly fades out. The disk becomes pale and atrophied. Embolism of the central artery occurs in persons suffering from organic heart disease, endocarditis, rheumatism, scarlatina, and Bright's disease. It often comes on during pregnancy and after puerperal septicæmia.

Retinal changes resembling embolism may result from a trauma causing a hæmorrhage in the nerve-sheath. Spasm of the retinal arteries may also cause sudden transient blindness.

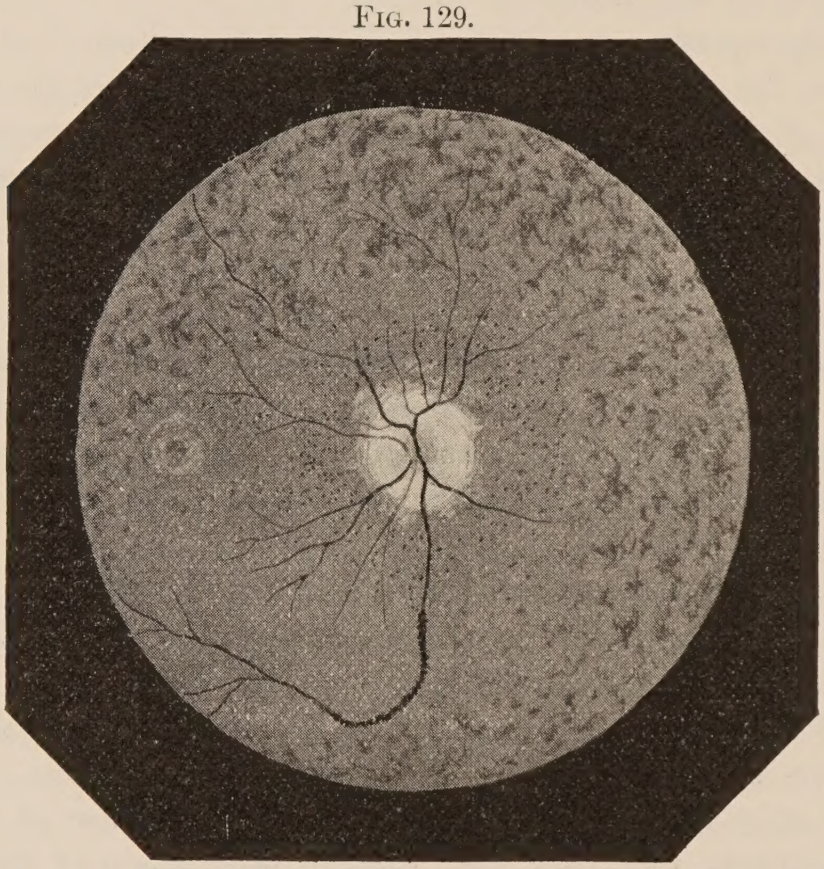
Surgical measures, such as iridectomy and paracentesis of the cornea, have been resorted to, but without good results. Massage of the eye soon after the attack has restored a number of cases, but it seems probable that they were cases of obstruction of the veins or spasm of the arteries, and not cases of true embolism. Massage should be tried in all cases if seen soon after the occurrence of the obstruction. The use of the constant-current battery is reported as having produced favorable results, and it should be tried.

In all cases of prostrating diseases, such as scarlatina, typhoid fever, etc., where there are attacks of transient blindness in one or both eyes, great caution should be exercised in allowing the patient to sit up during the early period of convalescence.

Retinitis Pigmentosa.—This disease is characterized by a pigment degeneration of the retina, which presents a marked ophthalmoscopic appearance. The pigment-patches have been aptly compared to the

appearance of bone-corpuscles under the microscope. They are scattered at first over the retina near or even beyond the equator, but as the disease progresses the pigmentation extends toward the optic disk. In some cases only a segment of the retina is involved, and the amount of pigment varies greatly in different individuals. The arteries appear very small and thready, and the optic disk presents a dirty-white appearance of atrophy. The subjective symptoms are very characteristic. The field of vision becomes gradually contracted concentrically, and inability to see well in moderate light is a striking symptom. As the field narrows patients have trouble in getting around even in broad daylight. During this time central vision may remain acute enough to enable the patient to read, and yet he could not safely walk the streets alone. But gradually this fades out and total blindness results.

FIG. 129.



Retinitis Pigmentosa, with atrophy of the optic disk and choroidal alterations in the region of the macula lutea. There is a remarkable pigmentation along the course of one of the veins, running downward.

The disease is hereditary in a small proportion of cases. It often affects more than one member of the family. Its progress is very slow, and its advancement may continue over a period of twenty or thirty years before blindness comes on.

Internal medication seems to have no effect. The use of the constant battery is spoken of favorably by Dr. Derby of Boston in retarding the progress of the disease and in extending the field of vision. Strychnine hypodermically is credited with producing similar results. It is certainly advisable to try these remedies in a disease which offers such

slight chances of improvement. Mercury seems not to produce any good effect in these cases, and, as its use lowers the general nutrition, it should not be employed. A tonic course is advisable in all cases; especially should the preparations of iron be utilized.

Detachment of the Retina.—Detachment of the retina is a separation of this structure from the underlying choroid. It is caused either by an effusion of fluid beneath it or by the traction of contracting strands in the vitreous. It may originate in any portion of the fundus. When it is slight and located toward the periphery of the retina, it will cause little impairment of vision, there being only a scotoma to mark its presence. Where the detachment is extensive the field becomes correspondingly obscured. The progress of the detachment may be either rapid or slow. Patients will describe it as a dark cloud which seems to settle down, slowly obscuring vision in one direction. The progress may be so rapid that it can be noted from time to time. In other cases it comes on at night and the defect in the field of vision is first detected in the morning. It may follow an effort at lifting some heavy substance or even from stooping. It is not associated with pain, but may present subjective symptoms, as muscæ or sparks and flashes of light. When the macula is not involved central vision will remain good. In a pronounced case of detachment of the retina the ophthalmoscope shows the retina bulging out like a large vesicle. It presents an undulating motion when the eye is moved. The vessels of the retina have a dark appearance, which Berry explains as "due to their being seen to a great extent by transmitted light, just as the striæ of an incipient cataract appear black when examined with the ophthalmoscope." When the detachment is slight or is just beginning, it has a wrinkled or corrugated appearance. When it is occasioned by the presence of a choroidal tumor, it has very limited motion and is generally opaque. The retina often remains transparent for a long time, but finally becomes opaque.

Among the causes of detachment of the retina, myopia is certainly the most frequent. Statistics show this cause in from 48 to 60 per cent. of all cases (excluding those due to trauma). Detachments due to trauma are more favorable than when due to effusion of fluid under the retina or alterations in the vitreous. Injury is a frequent cause. Pregnancy and parturition may be the causes in a limited number of cases. Albuminuria, diabetes, erysipelas of the face, and neuralgia of the fifth nerve have appeared in a small number of cases to be the cause of retinal detachment.

Both medical and surgical measures have been resorted to in the treatment of this intractable disease. Varying results have followed the different plans, but on the whole the number of complete or even partial cures is not large. A few cases of spontaneous cure have been reported.

Rest in bed is certainly one of the most efficient measures in the treatment of detachment of the retina. The earlier it is begun after the detachment the more likely it is to produce favorable results. In order to be effective the patient must remain in bed from one to three months. If, however, there is no improvement in the field of vision in ten days or two weeks, we cannot expect the rest cure to accomplish anything. Rest in bed must be combined with internal treatment. A light saline purgative may be given every day or every second day. Rochelle salts (1 to 2 drachms) in a glass of hot water, a glass of Hunyadi water, or the effervescing saline aperients will answer the purpose. A grain of calomel at bed-time may be used instead of the salines mentioned. The diet should be restricted, and only easily digestible foods taken. Rest in bed with the use of pilocarpine or jaborandi has been extensively tried, and with some good results; for the use of which see treatment of Diabetes, Volume I.

Dr. O. F. Wadsworth reported a case of albuminuria of pregnancy with extensive detachment of retina in both eyes. One-sixth grain of pilocarpine was given her with the effect of diminishing the detachment. Premature labor came on with convulsions, and upon recovering consciousness she could only see motions of the hand before the eyes. Six weeks later detachment in each eye had disappeared and vision was improving.

The methods of surgical treatment for detachment of the retina are as follows: Puncturing the detached retina to allow its contents to escape into the vitreous was years ago resorted to by Bowman of London and Graefe of Berlin. A very natural procedure was to puncture the sclera and allow the subretinal fluid to escape in that way. This has been tried by Arlt, Hirschberg, and others. Some years ago De Wecker inserted a gold wire into the sclera, which he hoped would act as a drainage-tube. The results following all these procedures have not been encouraging.

Dr. J. R. Wolf operates only when there is no opacity or softening of the vitreous, the retina is healthy, and the effusion is purely serous. His operation is as follows: The sclerotic is laid bare at a point corresponding to the detachment. An incision is made through the sclerotic obliquely into the sac formed by the fluid. Gentle pressure is made upon the eyeball in the track of the receding lance by means of a fine spatula. The eye is closed with plaster and not opened until the sixth day; on the eighth day the eye is tested.

Galezowski recommends the horizontal position for several weeks. Boucheron advises immediate iridectomy with the idea of improving the condition of the uveal tract, and the relief of rheumatic and uræmic conditions by pilocarpine and rigorous systemic regimen. De Wecker has found surgical measures useless in many cases, but the

compress bandage and rest have proved useful. He also tries a special plan of evulsive treatment, consisting of repeated applications to the sclera of heated points (*pointes de feu*). Dor orders the recumbent position for four weeks, applies the artificial leech once each week, and gives pilocarpine daily.

The general consensus of opinion is that the traumatic cases are much more amenable to treatment than others.

Cure of detachment of the retina by injections of tincture of iodine has been performed by Galezowski of Paris and Schoeler of Berlin. The former injects the tincture behind the detachment, and the latter in front of it. The results obtained by Schoeler are very encouraging. The object of this treatment is to produce adhesive retinitis, which shall counteract the tendency of the shrinking vitreous to pull the retina forward. In the cases reported vision was much improved, the field of vision expanded, and partial or complete replacement of the retina obtained. From 2 to 6 drops of tincture of iodine are injected in each case with a Pravaz syringe.

Glioma of the Retina.—Glioma of the retina is a malignant disease which generally occurs in children under ten years of age. It is recognized in its early stages with the ophthalmoscope by a peculiar yellowish reflex from the fundus. Its growth is generally slow at first, but as the tumor increases in size its development is very rapid. In the early stages there is no pain, and no inconvenience so long as the fellow-eye is good. It is often discovered by the parents or friends of the child, who accidentally catch a glimpse of the peculiar reflex from the fundus. It does not cause pain until it so far fills the ball as to cause increased intraocular tension. This pain becomes continuous and excruciating until it perforates the sclera or the globe is enucleated. When it breaks through the sclera and invades the orbital tissue it increases in size with great rapidity. It must be distinguished from pseudo-glioma, which resembles it in appearance in the early stages. This is due to the inflammatory alterations in the vitreous and runs through certain stages, when it becomes stationary. Glioma is microscopically a round-cell sarcoma.

Internal medication is of no avail. The only safe measure is to enucleate the eye as soon as possible after the diagnosis is made. It is well to cut the nerve off as near as possible to the apex of the orbit. If the nerve is found enlarged, it is quite certain that the growth will return. If the sclera has already been perforated, it is better to remove the entire contents of the orbit down to the bone.

Glioma is almost certain to return even if the affected eye is enucleated soon after its development. There are, however, a few cases on record of a permanent cure.

DISEASES OF THE CHOROID.

Choroiditis; Choroido-Retinitis.

The choroid is the pigment and vascular tunic of the eye, and it aids the ciliary body in the nourishment of the retina and vitreous. It also performs an important office in the absorption of the rays of light which enter the eye. The amount of pigment varies in different persons, depending on the amount of pigment in the skin and hair. The variation in tints thus caused should be taken into consideration in using the ophthalmoscope.

The choroid is frequently the seat of disease. It may be limited to the membrane alone or it may extend to the retina, owing to the intimate proximity of these tunics. A localized or general choroiditis may pass through its various phases without attracting the attention of the patient. This can occur where both eyes are good and there is not much exudation into the vitreous.

The symptoms which first warn the patient are a diffuse haziness of the eye or a cloud or blur in one portion of the field of vision. If the central portion of the choroid is not involved, vision may be but slightly impaired and the eye may clear up rapidly. In other cases a scotoma may remain, which interferes very materially with perfect vision. In the early stages of an attack it will be difficult to determine whether the retina is involved, and it is only later on, after the inflammation has subsided and the exudation has been absorbed, that this point can be definitely settled. Again, there may be so much turbidity of the vitreous that one cannot definitely locate the area of the choroid which is involved. Generally there is no pain, but the subjective symptoms are more or less pronounced. There is a glimmering and wavering sensation before the eyes, with flashes and luminous appearances.

The pathological subdivisions of choroiditis are made in accordance with the more striking features which the various tissue-changes present, and we may designate them as follows: *serous*, *plastic*, *purulent*, *hæmorrhagic*, and *atrophic*, resulting from the others.

Serous Choroiditis is characterized by a serous exudation into the vitreous and increased intraocular tension. Von Graefe taught that glaucoma was a serous choroiditis, and the question of the causation of this obscure and much-dreaded disease has been discussed ever since his time. As glaucoma properly falls into the hands of another author, it will be passed by without further comment.

Plastic.—Plastic choroiditis is characterized by plastic exudations into the deeper or superficial layers of the choroid, which are associated with changes in the retina as well as the vitreous. In some cases the

vitreous is full of dust-like exudation which can be seen to make excursions from side to side as the eye is rotated. It includes choroiditis areolaris, disseminata, centralis, and choroido-retinitis syphilitica. A large proportion of all cases of this class are of syphilitic origin, and they appear among the later secondary symptoms.

Purulent.—Purulent choroiditis is marked by a purulent infiltration of the choroid, soon developing into a general purulent panophthalmitis. Nearly all cases of purulent choroiditis are due to traumata of various kinds—punctured and excised wounds, penetrating and perforating wounds, and surgical operations on the eye. They are also due to metastasis, septicæmia, and embolism of the choroidal arteries and thrombosis of the veins.

Hæmorrhagic.—The hæmorrhagic form is characterized by hæmorrhages more or less extensive, which when absorbed leave atrophic patches bordered by pigment. The hæmorrhages may be so extensive as to detach the choroid, or if from the anterior portion of the choroid may cause detachment of the retina, or they may perforate the retina and escape into the vitreous. There is a tendency to a recurrence of hæmorrhages, and they may occasion such an alteration in the consistency of the vitreous body as to cause its liquefaction or a considerable shrinking of its mass, and subsequent detachment of the retina.

Atrophic.—From the above forms there is likely to result a general atrophy of the pigment epithelium of the choroid or larger or smaller patches of white, which present a striking appearance with the ophthalmoscope. The atrophy may be partial or complete. It may involve the periphery to the exclusion of the central portion, or its effects may be reversed and the central portion alone suffer.

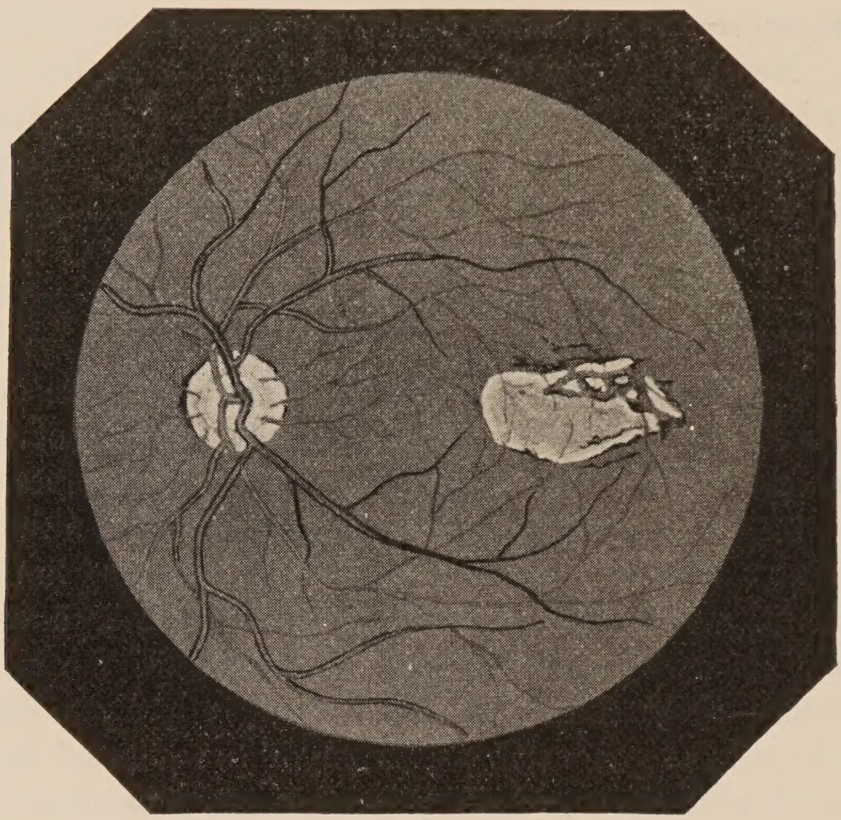
Ophthalmoscopic Types.—Some of the ophthalmoscopic types of choroiditis are well defined and readily recognized, and present such a uniformity of appearance that they can be classified.

The different forms of choroiditis mentioned above present a variety of ophthalmoscopic pictures. The location and size of the area involved, the amount of pigment in the choroid, the severity of the inflammation, and constitutional conditions determine the result so far as the appearance is concerned.

Central Choroiditis is somewhat uniform in its appearance. It is one of the forms of choroidal inflammation which is most likely to be seen in its early stages. It so uniformly affects central vision that advice is sought for at once. In its early stages there is usually a yellowish exudation in the macula or in its vicinity. This may not be more than 1 or 2 millimetres in diameter, or it may be as large as the optic disk or larger. There is frequently a fringe of hæmorrhage around it, and a slight haze of the retina in front of it. The rest of the fundus may present a normal appearance. If the mac-

ula itself is involved, the scotoma will be dense and central vision obliterated, but if not the scotoma will be less dense. Haab[1] discusses diseases of the macula lutea, and concludes that the greater vulnerability of the macular region accounts for its being the seat of election

FIG. 130.



Central Choroido-Retinitis.

of changes resulting from defective nutrition and disturbed vascular conditions which other parts of the retina are able to withstand. Regarding the vulnerability, he suggests that it is not entirely due to the complex anatomical structure and peculiar retinal blood-supply, but also to the central functional activity of this part of the retina and the great demands which are made upon it.

There is a form of central choroiditis which is seen in persons in advanced years and is known as Tay's choroiditis. It differs from the above in that there is not so much exudation. It is more chronic in its course, and there are, according to Nettleship, changes which resemble a retinitis albuminurica.

The forms of choroiditis known as *disseminate*, *circumscript*, and *areolar* present appearances which are subject to numerous variations. The arrangement of the pigment is very diverse: now it is piled up in masses, and again it is absorbed, leaving white patches of sclera showing through. The patches assume various shapes and sizes, being sometimes aggregated and again separated by a consider-

[1] *Oph. Congress, Heidelberg* (*Oph. R.*, 1889, p. 145).

able distance. The periphery is more involved at times, in which case central vision does not suffer so much.

Staphyloma Posticum.—Myopic eyes present alterations of the choroid on the outer side of the optic nerve between it and the yellow spot. They are due to an atrophy of the choroid, and are brought about by the yielding of the sclera. Sclerotico-choroiditis posterior is not usually seen as an active process. This point will be referred to in speaking of malignant myopia.

Coloboma of the Choroid is a congenital absence of the choroid in its lower portion. The coloboma may extend from the periphery to and around the disk, and may or may not be associated with coloboma of the iris. The retinal vessels are seen traversing the exposed sclerotic.

Congenital Choroiditis.—There are occasionally seen in children large patches of choroidal atrophy fringed with pigment in the central portion of the fundus, which have been attributed to intra-uterine inflammations. They generally cause great impairment of vision and are irremediable.

In spite of the accurate and exhaustive studies which have been made of choroiditis in its various forms, we must admit that we cannot always rely on the appearances which the fundus presents to guide us in determining the etiology of the disease. For instance, we cannot draw the line sharply between syphilitic and non-syphilitic choroiditis.

The dust-like particles in the vitreous, according to Förster, are not always evidence of syphilitic taint. Mr. Hutchinson in a paper read before the Ophthalmological Society of the United Kingdom, Jan. 31, 1889, said "that he had sought diligently, but quite without success, for any guiding symptoms by which to distinguish the cases of choroiditis which were not syphilitic from those which were. He presented, in illustration of what he said, a great number of very good drawings, and he was quite sure that if he were to place them all side by side on the table, no one would be able, by referring to the appearance presented, to pick out the non-syphilitic ones."

In studying the ophthalmoscopic types of choroiditis we must always remember the intimate relationship existing between the choroid and retina. Inflammations of the capillary layer are especially liable to involve the retina.

De Wecker says that "there is scarcely any form of choroidal inflammation which does not determine a change in the pigmentary epithelium of the retina. Therefore, strictly speaking, the term choroiditis should not be used, but should be replaced by that of retino-choroiditis."

Noyes says that "from the intimate physiological relations of the choroid with the optic nerve and retina all these parts participate to a

greater or less degree in their several inflammatory processes, and we often draw distinctions which must be inexact, and yet are justified by their conspicuous features."

It is estimated that from 60 to 80 per cent. of all cases of choroiditis are of acquired syphilitic origin. Of the rest, some are due to inherited syphilitic taint, malaria, metastasis, to febrile conditions, and other less definitely known causes.

Antisyphilitic treatment must be relied on in the management of nearly all cases of choroiditis. Mr. Hutchinson says that his studies of choroidal diseases have justified him in urging that, whatever the stage and whatever the diagnosis, whether of syphilis or otherwise, mercury ought to have a prolonged trial in all cases. We have then to choose the form of mercury which will best answer the purpose and accomplish the desired end in the most satisfactory manner. There are many preparations to choose from, and a preference may be given to one over another in certain cases.

For internal treatment the bichloride of mercury is very generally prescribed. There is not much tendency in it to produce ptyalism, and when taken after meals it is not liable to produce irritation of the stomach. It may be given in aqueous solution or pill form. The former is the preferable way:

℞. Hydrarg. chloridi corrosiv., gr. $\frac{1}{2}$;
Aquæ destillatæ, f℥ij.
Sig. Take one or two tea-spoonfuls after each meal in a wine-glass of water.

Taken in this way, it probably produces the minimum amount of gastric irritation. It can be given in the compound tincture of cinchona where a tonic is indicated, or in the compound syrup of stillingia. In pill form it sometimes irritates the stomach, but when it does not it is a convenient and excellent method of giving the drug. The present elegant method of preparing pills or granules renders them very desirable. These pills are made by many of the principal manufacturing chemists in strengths of $\frac{1}{50}$, $\frac{1}{30}$, and $\frac{1}{20}$ grain. Other forms of mercury can be used in the same way as the biniodide and the protiodide. Hydrargyrum cum cretæ is an excellent preparation for children and delicate women. It can be given in doses of 1 to 5 grains in powder or tablet triturates.

Mercury by inunction is a most valuable method of rapidly influencing the system. It can be used in the officinal unguentum hydrargyri or as an oleate. It can be rubbed into the skin over the sides of the chest, over the groin, over the abdomen, in front of the elbow-joints, and over the temples. From 1 to 4 drachms may be used daily,

using one-half the amount mornings and evenings. It is best rubbed in with the hand. The skin should first be thoroughly washed with warm water and soap. By using different localities in succession there is less liability of producing irritation or eczema of the skin.

Mercury is also used with the most satisfactory results hypodermically. The bichloride is generally prescribed, but calomel has some advocates:

℞. Hydrarg. chloridi corrosiv., gr. ½;
Aquæ destillatæ, fʒj.
Sig. Inject five to ten minims twice a day.

The skin on the outer portion of the arm (not the forearm) is a convenient place to use the injection, but the back or abdomen may be chosen. Care should be taken to wash the skin with an antiseptic solution first. The hypodermic needle should be sharp and free from rust, and it is well to rub it thoroughly with a piece of chamois before using. Precautions of this kind go far to prevent abscesses of the skin. The advantages claimed for this method are the freedom of the digestive organs from irritation and the rapidity with which it shows its influence.

Förster[1] relies on mercurial inunction, and continues its use until mercurial stomatitis is developed. He keeps patients in a dark room for a month, and in bed most of the time. He uses corrosive sublimate and calomel, but thinks relapses are liable to occur after their use. The artificial leech is a valuable aid to the mercurial treatment.

Iodide of potassium is used in choroiditis, either alone or in conjunction with mercury. It is best given dissolved in water, and when taken should be diluted with half a tumbler of water. It is better taken before meals, but authorities differ on this point, and some prefer to administer it after meals, so that its elimination may not be so rapid. The dose varies very greatly. One can begin with 5 to 10 grains three times daily, and increase rapidly to a drachm at each dose. Much larger doses are given in some of the tertiary forms of syphilis. The iodide is also given as enemata in doses of 1 to 4 drachms daily.

Hot-air and vapor baths by their action on the skin have a very favorable influence on the acute plastic and exudative forms of choroiditis, as well as in cases which have passed into the chronic stage. They seem to aid the remedies which are given internally. In the form of Turkish or Russian baths they are to be had in nearly every city. A hot-air bath or a vapor bath can be extemporized in almost any house.

[1] *Graefe's Arch.*, vol. xx.

Pilocarpine and jaborandi have been very extensively used, and the results from them have been very gratifying. The former is used hypodermically, beginning with $\frac{1}{12}$ grain and increasing to $\frac{1}{6}$ grain. Care should be taken in its administration, as it occasionally produces very unpleasant effects on the heart. It does not always produce its specific effects on the skin, but it seems to spend its force on the salivary glands. There is profuse salivation for an hour or more, which then subsides. The skin in these cases has a hot, burning feeling. Notwithstanding the inactivity of the skin, it still has its beneficial effects, but not to the same degree. The injection should be given to the patient in bed. Extra blankets should be thrown over him, and sweating encouraged in this way. After the effects have passed off the skin must be rubbed with a dry towel before dressing. This can be repeated once a day in vigorous persons where prompt effects are desired, but for many patients once in two or three days will be frequent enough.

Fluid extract of jaborandi is given in doses of 30 to 40 minims in hot tea. The same precautions should be observed in the care of the patient as in the use of pilocarpine.

Bloodletting by means of the artificial or natural leech is indicated in the early stages of choroiditis. From four to six leeches should be applied at once. Half the number of leeches used should be placed close to the inner and outer angles respectively. The artificial leech (Heurteloup's) should be applied to the temples. From 2 to 4 ounces of blood can be extracted. (For further treatment see article on Syphilis in Vol. II. of this System.)

Sclerotico-choroiditis Posterior; Myopic Choroiditis; Malignant Myopia.—It is a well-known fact appreciated by every student of the eye that a myopic eye is, as Donders said in his incomparable work on *Refraction*, not a "sound eye." It does not follow that myopes do not enjoy good vision, and that they may not live a long life without suffering seriously from this anomaly of refraction, but it does mean that myopia beyond a certain degree is or may be a source of serious impairment of vision. Just where the danger-line lies depends on many conditions, and it is not the same to all persons. A person with a moderate degree of myopia may enjoy excellent vision and may not suffer any inconvenience beyond the wearing of glasses. His eyes may be well adapted for close work and accurately adjusted by lenses for distant vision. He may even have good working eyes whose M. is 5 D. or 6 D., and yet, as myopic eyes go, he may get along comfortably. Still, there is danger here, and it increases as the degree of myopia is higher. In eyes myopic to any degree there are evidences of intraocular changes which are visible with the ophthalmoscope. These are alterations in the choroid on the temporal side

of the disk known as posterior staphyloma. The choroid is generally atrophied in the form of a crescent, and the white sclerotic shows through. This atrophy assumes different shapes and sizes: there may be narrow or broad crescents; there may be a broad patch of the width of the disk extending directly outward toward the macula; or the atrophy may extend entirely around the disk.

In addition, there are other alterations in the choroid, consisting of patches of atrophy more or less extensive, a stippled appearance around the macula, or a general atrophy of the choroidal pigment. These changes around the optic nerve and in the choroid are due to a yielding of the sclera, so that the antero-posterior diameter is increased. The thinning of the sclera is very marked in cases of high degree of myopia. These changes in the choroid and sclera are so gradual that we cannot say they are due to an inflammatory process in the ordinary acceptation of the term.

The causes which bring them about are numerous, and date not only from childhood, but to hereditary influences. The generally-accepted opinion is that the majority of new-born infants are hyperopic. As the child grows and begins to use its accommodation for near objects various factors combine to develop the myopia: overtaxing the eyes, faulty position of the body at school, imperfect illumination, and hereditary tendency.

The influence of heredity is shown very early, and is one which should be seriously considered, as it renders possible a series of alterations in the eye which may result in partial or even total loss of sight. At first the child holds objects closer than usual, but little is thought of this until school-life begins. Then it is discovered that the characters written on the blackboard cannot be seen distinctly. An examination follows, which proves that there exists a degree of myopia which interferes with the comfort of the child. If examinations are made at intervals, it will be discovered that the myopia has slowly increased, and in addition there is a muscular asthenopia which is very annoying, and which leads finally to divergence. It is fortunate for the child if this discovery is made early, so that the necessary regulations for the use of the eyes can be made to check or limit as much as possible the advancement of the myopia. These changes take place not only in the eyes of a child who inherits myopia from one or both of the parents, but also in one who up to a certain period has had emmetropic eyes.

During school- or college-life, or where the young man or woman is engaged in occupations which are trying on the eyes, vision for the distance fails, and finally a permanent myopia is established. Fortunately, there is a tendency in myopia, whether inherited or acquired, to become stationary. This may take place in from the eighteenth to the twenty-first year, but is known to be much later in exceptional cases. We have

then low or moderate degrees of myopia where the myopia advances to a certain degree and becomes stationary. Good vision is still preserved, and with proper correcting lenses the eyes are strong enough for all ordinary use and excellent vision for distance is obtained. In moderate degrees of myopia, where there is no disproportion between convergence and the accommodation, the eyes are particularly well adapted for close work. This comfortable state of affairs may never be disturbed by muscular or choroidal complications.

In the higher degrees there comes on slowly-marked disproportion between convergence and accommodation. Binocular vision becomes difficult and distressing asthenopic symptoms supervene. There is a tendency to divergence which increases, and finally becomes a fixed condition. Comfort of the eyes and freedom from diplopia are obtained at the sacrifice of binocular vision. Then follows the amblyopia of the diverging eye, which increases year by year.

But the form of myopia which excites our anxiety and which produces such disastrous effects upon vision is that known as malignant myopia. It has been described as progressive and pernicious—words which vividly express its character. It is characterized by hyperæmia of the disk and an involvement of the choroid in the posterior pole of the eye. The choroid around the nerve on the outer side is atrophied, and a white scleral crescent or ring is formed; absorption or thinning of the choroidal pigment follows; sometimes a disseminate choroiditis is directly attributable to progressive myopia. Then there are exudations and hæmorrhages in the region of the macula which seriously impair vision. The choroid as far forward as the ciliary may be implicated, so that the nutrition of the vitreous as well as the lens is impaired. Ectasia of the sclera comes on slowly and causes a strain upon the choroid and retina, and finally from these mechanical causes, combined with alterations in the vitreous, we have detachment of the retina. Other factors, such as the visual act itself, the stimulus of light upon the retina, the compression of the extrinsic muscles (points which cannot be discussed here), aid in bringing about the disastrous results mentioned. These changes do not always come on in the early years of life. Even in middle life and beyond the myopic eye after years of quiescence may be the seat of inflammations of the choroid and retina which will terminate in serious impairment of vision.

Myopia, then, proves itself to be something more than an error of refraction. It is indeed an ametropia, but it is one associated with complications which may result disastrously.

Landolt says that "the choroiditis which accompanies malignant myopia communicates itself very easily to the sclerotic, renders it less resistant, and thus brings about the ectasis of the ocular globe." This

inflammation may be directly and indirectly the cause of detachment of the retina and liquefaction of the vitreous, as well as other alterations of the eye.

The causes of malignant myopia are, according to Landolt, as follows: Ocular work at short distance; bad arrangement of desks, tables, and seats; excessive fineness of work; insufficient illumination; badly-ventilated rooms; and stooping position of the head. Together with these is the natural physical weakness which unfits some for prolonged work.

PROPHYLAXIS AND THERAPY.—The seeds of a future progressive myopia are often sown in early childhood. Care should be taken with the toys that are given to little children. There is a disposition in them to bring objects close to the eyes, which should be prevented as much as possible. Some of the Kindergarten work is certainly trying to the eyes, such as the pricking work and the plaiting of narrow strips of bright-colored papers. Children should be encouraged to indulge in out-door sports where the eyes will be free from strain. The seats at school should be carefully constructed, so that the feet will not be suspended above the floor, and the illumination should be so ample that the eyes will not be subjected to an extra effort while at work.

The following is a summary of the views expressed by Landolt: There must be a constitutional treatment which will tend to invigorate the system and improve and keep up the nutrition. The use of the eyes must be regulated even from infancy, especially where there is hereditary tendency to myopia. Games should be encouraged which require walking and running out of doors. Chairs and desks must be properly and comfortably arranged in accordance with the requirements of the child. Work at home or in school must not be too prolonged, but interrupted occasionally. There must be a good illumination, both natural and artificial. Books should be selected with clear type. The ametropia should be corrected, so as to give the eye the best visual acuity both for near and far.

In malignant myopia the most important things are the dark room and absolute rest. Under the soothing influence of the obscure light the hyperæsthesia of the retina subsides and the congested condition of the choroid is lessened. Heurteloup's artificial leech should be applied to the temple or natural leeches may be used. Pilocarpine may be given internally in doses to suit the condition of the patient. Paracentesis of the anterior chamber in extreme cases may be necessary. This diminishes the intraocular tension and relieves the pressure.

But with all these adjuvants the chief thing is rest. It may be necessary to take children out of school for a few weeks or a few months, or even longer. During these periods they should be out of doors as much as possible, and should abstain from all use of the eyes.

Examinations should be made from time to time and careful tests of vision recorded. In this way the progress of the case can be watched.

The *adjustment of lenses for myopia* should be done with the greatest care. Upon this will depend the comfort of the patient, and to some extent at least the progress of the myopia. Myopic eyes which are accurately fitted with glasses are brought as nearly as possible to the standard of the emmetropic eye. This naturally favors comfortable use of the eyes and prevents strain upon the accommodation. The accommodation should be paralyzed by homatropine or atropine and the error recorded, and great care should be taken to correct any astigmatism which is found. The question of ordering glasses will depend on the degree of myopia. In low degrees where vision is fairly good for distance we can order glasses to be used *only* on special occasions where sharp vision is required, as for looking at pictures or landscapes or for use at the theatre, church, or school. There is good authority for correcting the myopia fully, and instructing the patient to wear the glasses all the time. In this way he has the best vision possible for distance, and by holding books and papers at the proper point can see equally well for near. His eyes are then as nearly as possible in the condition of the emmetrope, and this correction is known to have a favorable influence on the progress of myopia, as it relieves the excessive convergence which is required, and prevents the stooping posture. Many such myopes wear the same lenses until they have reached that time of life when presbyopia develops. Then they require weaker lenses for reading or none at all.

There is a muscular asthenopia in the higher grades of myopia which leads to many distressing symptoms, and finally to a positive divergent strabismus. The weakness of the interni renders convergence during accommodation very difficult, and an annoying diplopia is the result. In order to get rid of this, one eye diverges, and in time its image is ignored. Comfortable use of the eyes is acquired at a sacrifice which it is well to avoid if possible. The measures to which we can resort to prevent this sacrifice are the adjustment of glasses above referred to, the combination of prisms with the lenses to aid the weak muscles, and, when milder means fail, tenotomy of the stronger muscles. The surgical treatment of muscular asthenopia is a question which requires our best skill and judgment. The condition of the eyes, the relative strength of the opposing muscles, and the degree of lateral deviation should be carefully studied before surgical interference is resorted to. Whether we shall tenotomize the stronger or advance the weaker muscle are questions for mature deliberation.

All of these questions concerning myopia involve much more than the study of an error of refraction only. The integrity of the two tunics so essential to vision is at stake, and our advice should be given

with reference to the present as well as the possible remote conditions which may arise.

It is very certain that spectacle-venders, and often opticians, do much harm by prescribing concave glasses for young persons. This they should never be allowed to do. Every oculist has seen cases where much harm has been done in this way, to say nothing of the harm they do by prescribing for all other anomalies of young persons. Spasm of the ciliary in a hyperope is mistaken for myopia, and he is given a pair of concave lenses, which only increase his hyperopia without relieving his asthenopia.

Fortunately, there are many things in favor of the myope of the present day. Among them is the knowledge of and interest in anomalies of refraction possessed by all intelligent physicians, and then there is the general intelligence on the part of the teachers of our public and private schools. They more frequently detect the ocular anomalies than do the parents, and when it is discovered that the scholar cannot see the blackboard distinctly, or when he holds the book too near his eyes, he is promptly requested to have the defect remedied. Parents notice these defects more than formerly, and they generally are very willing to second the teacher's endeavors to correct the ocular defect. Our school-houses are better constructed now, and the light better arranged, than even ten or fifteen years ago. Architects understand the necessities of the case and build the walls and locate the windows so that the best light is obtained. The seats which the scholars occupy are also more comfortable, and relieve the strain upon the back and prevent the stooping posture which does so much to produce congestion of the choroid.

Malarial Choroiditis.—It is a well-established fact that malaria exerts a deleterious influence on the eye and causes affections of the ocular muscles, the cornea, external and internal tunics. Malarial choroiditis presents peculiar characteristics, and its right to be called a separate disease is quite well established.

Effusions into the vitreous of undoubted malarial origin have been frequently observed. Dr. Seely at the eighteenth (1882) and twenty-first (1885) meetings of the American Ophthalmic Society reported cases of effusions into the vitreous which were of malarial origin. There was sudden and total loss of vision. The vitreous was opaque, and there was no red reflex except around the extreme periphery. Sulzer reports observations made in Java on soldiers[1] showing numerous ocular affections due to malarial cachexia. He notes diffuse infiltrations of the vitreous, chronic optic neuritis, and numerous small peripheral hæmorrhages into the retina.

De Schweinitz[2] cites several cases and reviews the literature upon

[1] *Zeh. klin. Monat. f. Augenheil.*, vol. xxviii.

[2] *Med. News*, Jan. 7, 1890.

the subject, showing how almost every part of the eye may be influenced by malaria—the cornea, retina, choroid, and optic nerve.

We must rely on quinine in treating these cases. It should be given in liberal doses until cinchonism has been produced. From 10 to 20 grains per day can be safely given until the effects of the drug are manifest. At the same time the patient should be kept in a dark room, but he may be allowed to take exercise in the evening. The eyes should be protected from natural and artificial light by tinted shades. Arsenic may be given in the form of Fowler's solution or pills of arsenious acid, the former in doses of 3 to 5 drops, and the latter in doses of $\frac{1}{20}$ grain, three times a day. Arsenic will sometimes accomplish more than quinine in malarial troubles, and it is a good plan to give it after a course of quinine has been administered. Hot baths every day or two are recommended, or a hot pack or a Turkish bath occasionally. Change of climate sometimes has an excellent influence.

Metastatic Choroiditis.—Metastatic choroiditis is a septic inflammation which follows in the wake of puerperal fever, pyæmia, typhoid and scarlet fever, and other prostrating diseases. It comes on when the patient is very much reduced, and its presence may not be noticed in its early stages on this account. It is generally characterized by a yellowish or whitish reflex from the fundus, by a discoloration of the iris, and sometimes by hypopyon. The tension is often below normal, and there is tenderness to pressure. But it may assume a more violent type.

Wangemann[1] describes a case of bilateral metastatic ophthalmia which was characterized by the *very highest* degree of chemosis. It was of septic-embolic origin. Hirschberg reports a case which was quickly complicated by a ring abscess of the cornea. The writer recalls a case of metastatic choroiditis with marked chemosis and violent pain in a man aged about forty years who was suffering from typhoid fever. The symptoms were so urgent that it was necessary to incise the cornea and evacuate the pus.

In many cases, particularly in children, the manifestations are not so severe. There is not infrequently seen a peculiar reflex from the fundus which resembles glioma of the retina, but subsequent alterations in the eye will aid in differentiating between the two.

The inflammation is of embolic origin, as has been demonstrated by microscopic sections of the vessels. As it comes on while the patient is very much prostrated, its first development may be overlooked, but as it often advances rapidly it soon shows unmistakable evidence of its presence. It usually terminates in shrinking of the globe and total loss of vision.

[1] *Graefe's Arch.*, vol. xxxiii.

The inflammation may subside and leave the eye quiet and comfortable, although entirely blind. Where a chronic choroiditis associated with tenderness in the ciliary region sets in, the eye may become so annoying as to require enucleation. If the fellow-eye suffers from sympathetic irritation, the removal of the offending organ is advisable. In the early stages atropine is useful, especially where the iris is discolored. Cocaine can be used where its temporary anæsthetic effects are required. Warm fomentations may also be required. As the patient's condition is often critical, constitutional treatment to restore the health is of the first importance, and stimulants with tonics should be liberally given.

Tubercles of the Choroid.

Tubercles of the choroid are seen as small round whitish or yellowish-white spots, generally located around the optic nerve. They are sometimes aggregated, and again several deposits may be seen considerably separated from each other. The spots are surrounded by a narrow halo of red different from the surrounding choroid, which is generally normal in appearance. The number of the spots is usually from three to six, but there may be as many as fifty-two (Cohnheim). They vary in size from $\frac{1}{3}$ to 2.5 mm. (Gowers) in diameter. There is in pronounced cases an elevation of the tubercular spot which is evident with the ophthalmoscope, and in rare cases there is a well-defined tumor. Brailey removed the eye of a child two years ago in which there was a tumor as large as a pea located near the papilla which proved to be tubercular. As these tubercular deposits gradually increase in size and absorb or press aside the choroidal stroma, they are not surrounded by pigment-rings as in choroiditis. They can be distinguished from sarcoma by the difference in the elevation of the choroidal tubercle, as well as by the general appearance of the fundus. From metastatic choroiditis they may be differentiated by the absence of foci of septic influences, and also by the limited area of the choroid which is involved.

Optic neuritis is generally absent, but to this there are exceptions. Tubercles of the choroid occur most frequently in children from two to ten or twelve years of age, but they are occasionally seen in adults. Riessmann[1] gives in minute detail a case of tuberculosis of the choroid in a woman of forty-nine. The tuberculous mass caused a rupture of the sclera. Characteristic miliary tubercles were found within the eye. S. M. Burnett[2] reports a case of an unusually large tubercular tumor of the choroid in a mulatto girl of thirteen. The bacillus tuberculosis is not always found in the choroidal deposits.

[1] *Graefe's Archiv f. Oph.*, vol. xxx. 3, p. 251.

[2] *Archiv. of Oph.*, vol. xii.

Lawford[1] reports examinations of 4 cases of tubercle of the choroid, in 3 of which he found the tubercular bacilli.

Tubercles of the choroid present histologically the same structure that tubercles do in other parts of the body. As this manifestation of tuberculosis is almost without exception secondary and not primary, it may occasionally happen that the ophthalmoscope may aid in confirming a diagnosis of tuberculosis in other parts of the body. The ophthalmoscope does not always reveal all the tubercular deposits that are present. Some may be so far forward as to be practically out of view. The growth of these masses may be in different stages of development, and while some are visible others are not. Microscopic examinations of the eye have often revealed them, although they were not seen or even suspected during life. This may very easily occur, as they would not impair vision unless located in or near the yellow spot, and it is probable that they occur more frequently than is generally suspected.

Therapy must be directed to the general condition, but as these cases are with few exceptions fatal, it is of little avail. When the tubercular mass perforates the choroid or threatens to do so, enucleation should be performed.

Rupture of the Choroid.

Ruptures of the choroid result from foreign bodies of various kinds striking the eye. The posterior portion of the choroid usually suffers. They are generally crescentic in shape, with the concavity toward the optic disk. The injury is followed by choroidal hæmorrhages which at first conceal the rupture. When the rupture is in or near the macula there is liable to be annoying metamorphopsia or great impairment of vision. Where there is extensive choroidal hæmorrhage there is likely to be an absorption of the choroidal pigment and atrophy of the choroid. These injuries are followed not infrequently by atrophy of the optic nerve.

Treatment consists in rest, atropine, and cold compresses in the first stage. The patient should be confined to his room for a few days. After the blood has absorbed he may be allowed to go about as usual, but tinted glasses should be worn and rest of the eyes from all work should be insisted upon. During the stage of cicatrization the eye should be as free from irritation as possible. Vision should be tested from time to time, but ophthalmoscopic examinations should be made as quickly as possible, and not too frequently. Any ametropia of the sound eye should be accurately corrected, and a lens adjusted to the injured eye if it has retained useful vision.

[1] *Ophthalmic Review*, vol. iv. p. 343.

Tumors of the Choroid.

Tumors of the choroid are fortunately rare when compared with the total number of cases of eye disease. They may originate from almost any point of the choroid, but are located most frequently in the posterior portion. When they are so located that they do not interfere with central vision they may grow to considerable size before they attract the attention of the patient. When, however, they are situated at or near the macula lutea, they are likely to be detected before they have attained much size. As a rule, they are painless until their size begins to increase the intraocular tension. At this stage they are the source of great pain and suffering, which continue until the sclera yields and the tension is diminished or until the eye is enucleated. Their development is more or less rapid in different cases. The growth seems to be steady, and at times even rapid. They are readily recognized with the ophthalmoscope when the media are clear. Ordinarily they present a rounded outline and a dark color. As the retina is pushed forward in front of the mass, it shows a smooth surface which is quite different from the undulatory surface of a detached retina. Occasionally the earlier stages are associated with choroidal hæmorrhages into the vitreous, which obscure the growth and are apt to mislead the observer from the correct diagnosis. As the tumor develops, however, this point is usually cleared up. Where either the lens or the cornea is opaque or where the globe is shrunken, the diagnosis is surrounded with many difficulties. The increased intraocular tension, the character of the pain, and perhaps an ectasia of the sclera due to the pressure of the tumor will aid in the diagnosis.

Knapp divides the course of choroidal sarcoma into four stages: viz. first, commencement without symptoms; second, inflammatory and glaucomatous symptoms; third, extension to the surrounding structures; fourth, metastasis to remote organs.

Sarcomatous tumors of the choroid are generally pigmented, but a small proportion are unpigmented. The latter are designated as leucosarcoma, and occur in persons in whom the choroid is not rich in pigment.

It seems probable that injuries of the eye may have a remote influence in causing tumors of the choroid. There is not much tendency in these growths to recur in the orbit when the globe has been removed before the tumor has perforated its walls. If, however, the extraocular contents of the orbit have already been invaded, there is likely to be new development after the enucleation.

Metastasis.—There is a probability that sooner or later there will be a metastasis of the sarcoma to some of the internal organs, and preferably to the liver. This may occur within a year, or it may be

delayed four or five years, or even longer. There is then a general breaking down of the health, a rapid loss of flesh, and impaired nutrition. Doubtless many times sarcoma of the choroid and liver are present at the same time, as is evidenced by the early death of the patient after the discovery of the disease in the choroid. Is it improbable that the development in the choroid is secondary and not primary? If more frequent post-mortem examinations were allowed much light could be thrown on this point. There is also metastasis of carcinoma, and rarely of sarcoma, from the internal organs to the choroid. Such cases are not yet very numerous, but they prove conclusively that carcinoma as well as sarcoma of the choroid may be preceded by the same disease in other parts of the body.

The excision of the globe as soon as the diagnosis has been made is the only treatment which can be recommended. Even this is only palliative, and will not prevent the development of a similar morbid growth in the internal organs. It will, however, save the patient from much pain and suffering, and if done early prevent the orbital contents from becoming invaded. When the operation is done the optic nerve should be cut off as close to the apex of the orbit as possible. If the globe has been perforated by the tumor, it is advisable to remove the entire contents of the orbit down to the bone. This should be done as thoroughly as possible, and if the lids have been attacked by the growth they should be sacrified also. At the same time the general health should be maintained by nourishing food, freedom from care and responsibility, and sufficient exercise.

As sarcomata of the choroid are known to appear at a later period in the liver, the condition of this organ should be watched to see that its functions are properly performed. Any localized tenderness or enlargement should excite suspicion. It seems quite probable to the writer, from the observations of several cases of melano-sarcoma of the choroid in which no post-mortem examination was made, that from the *general* symptoms there were evidences of malignant development in the internal organs which antedated the choroidal disease.

Ossification of the Choroid.

This takes place in eyes that have long been blind and shrunken either from some suppurative process or from trauma. The development of bone does not usually occur until the eye has been blind for several years. It assumes different forms in different cases. Sometimes there are only a few spiculæ in the posterior portion of the eye. Again, there is a thin plate like a scale or there may be a complete cup or shell. This shell may extend as far forward as the ciliary processes. These formations are true bone, and are similar to those which take

place from periosteum. They are met with in various stages of development. They form in the plastic material which is thrown out from the capillary layer of the choroid in eyes which have suffered from irido-choroiditis, and they may be present for many years without giving any annoyance. In many, however, they cause severe pain at times and produce some irritation of the fellow-eye. This is liable to be brought about by a slight blow or an injury in the wearing of an artificial eye.

The diagnosis is easy, as the ossified choroid can frequently be felt through the sclera.

When the stump becomes tender and painful it is better to resort to enucleation at once. Delay only renders the patient liable to recurrent attacks of inflammation.

DISEASES OF THE VITREOUS (HYALITIS).

From a visual standpoint the transparency of the vitreous is of the greatest importance. Effusions, exudations, and hæmorrhages into it interfere very materially with distinct vision. The anatomical relationship between the vitreous and the membranes which surround it, the retina, choroid, and ciliary, make it the natural recipient of the inflammatory products of the membranes. These products may be septic, and excite a purulent inflammation which leads to total destruction of the eye. More frequently they are not septic in character, but consist of exudations, hæmorrhages, and serous effusions. Many of the products are capable of being absorbed, leaving the vitreous practically clear again.

Muscæ Volitantes are frequently seen in eyes which are otherwise healthy. They consist of alterations in the cell-elements of the retina which have consistency enough to cast a shadow upon the retina, but which are not visible to the eye of the observer. Sometimes they are transient and pass off with or without treatment, and again they remain for years. They cause great alarm until the person is assured of their harmlessness. Muscæ volitantes are frequently seen in ametropes when the error of refraction is either hyperopic or myopic.

Hæmorrhages into the vitreous can sometimes be recognized by their color as well as by the red impression which is given to the retina of the patient. They may be recurrent in their character, fresh hæmorrhages taking the place of those which have been partially absorbed. They may come from the retina, choroid, or ciliary, but probably more frequently from the latter. Large coagula are seen as dark masses which move very slightly. They naturally gravitate to the bottom, as do the

smaller and lighter ones, and then glimpses of the upper field can be had with the ophthalmoscope. Traumatic hæmorrhages are more likely to be entirely absorbed, other things being equal, than those which are the result of diseases of the internal tunics.

Not infrequently membranous opacities of the vitreous are seen. They are the product of irido-choroiditis, and are at times stretched from one point to another like broad bands, and present an opaque and solid appearance. They are generally associated with other opacities of the vitreous.

Malarial Affections are frequently accompanied by changes in the transparency of the vitreous. Effusions into this body due to malarial poisoning are sometimes very extensive and present the appearance of a solid opaque mass. The prognosis is usually favorable, and many cases are on record where they have disappeared without leaving a trace.

Syphilitic Diseases very frequently give rise to opacity of the vitreous. This may assume the form of fine dust which rises in clouds when the eye is rotated or in the form of shreds and filiform bodies. The opacity changes in appearance very quickly. At times it is absorbed with great rapidity, but this is only followed by a fresh opacity. Thus exudation and absorption may be repeated a number of times in a given case. Syphilitic inflammations of the iris and ciliary are very commonly associated with diffuse opacities of the vitreous. They may be so dense as to interfere with the inspection of the vitreous.

Purulent Inflammation of the vitreous (panophthalmitis) is generally due to trauma of some kind, an incised or punctured wound or a penetrating foreign body. It may also be due to metastasis, and occurs in puerperal fever, typhoid fever, and meningitis. The fundus oculi in such a case will present a whitish or yellowish appearance which resembles the early stages of glioma. In either case the prognosis is most unfavorable, as the globe may rupture in consequence of the accumulation of pus or it may be followed by a shrinking of the globe.

Menstrual Disorders are occasionally accompanied by hæmorrhage into the vitreous and exudations which give rise to diffuse opacities. The former may occur before or during the menstrual period and then disappear. The latter are more persistent, and may continue for months, and only be relieved when the uterine disease is cured. Permanent impairment of vision may also remain due to the choroidal origin of the vitreous opacities.

Hæmorrhages into the vitreous should be treated by rest and confinement in a darkened room. Local abstraction of blood either by the natural or artificial leech will often give excellent results. Small

doses of calomel ($\frac{1}{2}$ grain) or podophyllin ($\frac{1}{6}$ grain) should be administered once a day. Pilocarpine hypodermically, $\frac{1}{12}$ to $\frac{1}{6}$ grain, or fluid extract of jaborandi, 25 to 40 drops internally, is used with beneficial results. When the effusions are due to malarial poisoning liberal doses of quinine, 5 grains three times daily, should be administered. Here also rest in a darkened room is an important part of the treatment, as is also the regulation of the diet. Food in sufficient quantity should be taken, but meats and highly-seasoned articles of diet should be indulged in sparingly. Hot baths every day or two, or an occasional Turkish bath, should be taken. These should be followed by tonic doses of arsenic and strychnine. When the alterations in the vitreous are of specific origin an antisyphilitic course of treatment should be commenced and carried out persistently. Reference has already been made to the treatment of Choroiditis. Mercury in its various forms and iodide of potassium should be administered—the bichloride of mercury (grain $\frac{1}{20}$), the protoiodide (grain $\frac{1}{4}$), or the biniodide (grain $\frac{1}{16}$). Mercury by inunction, either in the form of the officinal unguentum hydrargyri or the oleate, is very valuable in many cases: 1 or 2 drachms per day should be thoroughly rubbed into the skin. Iodide of potassium in doses of 5 to 20 grains three times a day, well diluted in water, is given with the best effects. In the purulent or metastatic form there is not much to be accomplished by medicinal treatment. If the eye becomes painful, puncture of the ball to relieve the intra-ocular tension will have to be resorted to, but frequently enucleation is necessary.

Vitreous opacities dependent on some menstrual disorder or uterine disease can best be relieved by a course of treatment calculated to restore the uterine functions. Surgical interference is sometimes necessary in these cases.

The use of the faradic as well as the constant-current battery has produced some excellent results in promoting absorption of vitreous opacities. A number of writers have made favorable reports of cases treated by these means. The battery is generally used in conjunction with some internal constitutional treatment, so that its effects alone are not so well known. The writer has used the constant current in these cases, and has found that the absorption has been increased. From six to twelve cells of a Barrett's silver-chloride battery were used: one sponge was placed below the mastoid and the other over the closed eyelids.

Dr. Bull treats membranous opacities of the vitreous by incising them with a needle or slender knife. He reports 17 operations on 15 patients with favorable results in 14 cases. The eye is first cocainized, and the incision made just in front of the equator and below the insertion of the external rectus.

Parasites in the Vitreous.

Cysticercus in the eye is rarely seen in this country, but occurs most frequently in Northern Germany, where uncooked pork is freely eaten. Von Graefe saw it once in 1000 cases, and Hirschberg once in 500 cases. It may occur in the anterior chamber or under the conjunctiva, but it develops most frequently in the posterior chamber between the choroid and retina. It is recognized most frequently after it has perforated the retina. When the vitreous around it is clear, it can be seen with the opthalmoscope, and in some cases the motions of its head and neck can be detected. It presents a rounded outline, is fixed in its position, and its growth can be noted from time to time. Haab describes one floating in the vitreous as a "blue vesicle with shining margins." Finally, it leads to turbidity of the vitreous, irido-choroiditis, and destruction of the eye.

The only treatment is surgical. An incision through the sclera is made as nearly as possible over the seat of the parasite. When it is still subretinal it may be easily removed, as it will, in favorable cases, present itself in the wound. Where it is in the vitreous, it will have to be seized with forceps and drawn out. The eye is treated with compress bandages, cold applications, and rest.

The prognosis is good in a large proportion of cases. In a few excellent vision is preserved, in many useful vision, and in others the globe saved from enucleation.

Cholesterin in the Vitreous (Synchysis Scintilans).

Clouds of bright shining particles in the vitreous are sometimes seen which present a beautiful and interesting picture. As the eye moves from side to side these crystals look like showers of bright shining gold or silver scales which move with the eye. They may be deep in the vitreous or diffused throughout its substance. In some cases they are small and dust-like, and in others they are larger and less numerous. The vitreous is liquefied to a certain extent in these cases, and they occur more frequently in persons beyond middle life. They are not amenable to treatment.

Vascularization of the Vitreous.

It seems probable from examinations of the vitreous of enucleated eyes that new blood-vessels not infrequently form in it as a result of disease of the choroid and retina. Owing to alterations in the cornea or lens, or in the vitreous itself, these are not visible, but are discovered through the microscopic examination of the eye. It happens, however, occasionally that newly-formed blood-vessels are visible in the vitreous. Cases have been reported by V. Jaeger,[1] Mouthner,[2] Hirschberg,[3] and

[1] *Atlas.* [2] *Lehrbuch der Ophthalmoscope.* [3] *Centralblatt*, Feb., 1881.

Schweiger.[1] Chornley and Fox report three cases which were under their observation. Some of these cases improved under mercurial treatment, and others were not influenced by it.

In retinitis proliferans new vessels are formed in the vitreous. They are seen around the papilla and along the course of the larger vessels, and form a dense flat meshwork.

AMBLYOPIA AND AMAUROSIS.

AMBLYOPIA is a term applied to that condition of the eye in which, while there may be some vision, yet the ophthalmoscopic findings are not sufficient to account for the defect. The fundus oculi may present a perfectly normal appearance, or the changes may be so slight as not to be in proportion to the impairment of visual acuity. The condition may be permanent, as in *amblyopia ex anopsia*, or temporary, as in hysterical or toxic amblyopia. An amblyopia may precede atrophy of the optic nerve, as, for instance, in concussion of the brain or retrobulbar neuritis. Amblyopia may involve the central portion of the field of vision, or one-half of it, as in hemianopsia. Amblyopia is often associated with nystagmus.

Congenital Amblyopia.—Every observer has frequently seen cases of monocular amblyopia in which there were no ophthalmoscopic differences in the appearance of the two eyes. This condition doubtless exists more frequently than is generally supposed. It is not associated with squint, and is often not discovered until adult life. It is probable that some of these eyes could be improved by persistent, faithful exercise of the eye, but patients with one good eye will seldom take the trouble to carry out the treatment long enough. Only one such case has ever come under my observation where the patient had this dogged perseverance. It was in the person of a young lady who expressed her willingness to carry out the treatment. With a large reading lens she exercised the weak eye a few minutes at a time each day. After months she was able to lay aside the lens, and when seen two years later she could read ordinary print fairly well.

There is a binocular amblyopia in children who have a high degree of hypermetropia or compound hyperopic astigmatism. Vision can be brought up probably to 0.1 to 0.2 with the best correction. These cases are often found to have better vision two or three years later. This is probably due to the combined effects of mental development and the skill acquired in using the lenses to the best advantage, and to an actual improvement in visual sensibility of the retina.

[1] *Handbuch.*

Treatment consists in giving the best possible correction of any existing anomaly and instructing children to wear glasses constantly. Systematic use of the amblyopic eye should be recommended.

Amblyopia ex Anopsia.—This term is generally applied to cases of strabismus to denote the amblyopia of the squinting eye. Want of parallelism of the eye is given as a sufficient reason for the amblyopia. While the fact is unquestioned, yet the cause is not sufficient to explain all cases of monocular amblyopia. There are many cases of amblyopia of one eye in which the eyes do not squint. The fundus is in all respects healthy, and yet the eye is as defective as a converging eye. Hypermetropia is doubtless a factor in the causation of many cases of squint, but if it were the principal factor the number of such cases would be greatly multiplied.

The amblyopia of a squinting eye is often improved by a tenotomy of the converging muscle, and if systematic exercise of the eyes were persevered in for a long time it is probable that useful vision might be acquired in a portion of the cases.

Any ametropia of the good eye should be corrected. The amblyopic eye should be placed in the gymnasium, as it were, for systematic exercise and training. For this purpose a hand magnifying lens is best. The good eye should be bandaged and the lens held before the amblyopic eye at a proper distance from the test type. Large letters should be practised on first, and smaller ones can be gradually used. The exercise should not last too long at first—not long enough to exhaust the eye. When the eye has improved sufficiently the lens can be dispensed with. The time which it will take to improve an amblyopic eye is so great that very few will have the patience to persevere. It is doubtless true that many amblyopic eyes are not capable of being improved even by long-continued exercise.

Cases of strabismus which cannot be relieved by the adjustment of lenses should be *carefully* tenotomized. At the same time the proper correcting lenses should be worn constantly, and the use of the eyes regulated for study or work as may be necessary.

Toxic Amblyopia.—Under this head we may class as the most fruitful source of toxic amblyopia the excessive use of tobacco and alcohol. In the earlier stages there is a central scotoma more or less dense, with impairment of color sense, but no limitation of the field of vision. The optic disk presents a hyperæmic appearance, but the rest of the fundus appears normal. Later on the temporal sides of the disk show a blanched condition, and a permanent amaurosis may remain.

Quinine Amblyopia.—This is due to large doses of the drug and is transient in its effects. The ophthalmoscopic examination may reveal an ischæmic condition of the retinal arteries and veins, or it may be

practically negative, but the amblyopia may be for the time being profound. At the same time and from the same cause there are deafness and very annoying tinnitus aurium.

Lead-poisoning Amblyopia.—In these cases we have a central scotoma without limitation of the visual field, as in toxic amblyopia. The history of the case and the associated paretic symptoms will aid in the diagnosis. Quite frequently, however, there is a neuritis which terminates in atrophy of the optic nerve and hopeless amaurosis. The treatment of these forms of amblyopia has been considered under the Diseases of the Optic Nerve, and need not be repeated.

Hysterical Amblyopia.—This form of amblyopia occurs more frequently among females and is due to some menstrual or ovarian disorder. Suppression of menstruation due to exposure to cold may bring it on. The confinement of boarding-school life or intense application to studies or any event which may disturb the mind may be sufficient to excite it. It is seen also among men, and is due to mental excitement or overwork. More frequently it affects one eye, but occasionally both eyes are involved. It may involve only half the field of vision, but generally the entire field is obliterated. It may be distinguished from amaurosis by the activity of the pupils.

In menstrual disorders the normal functions of the uterus should be restored as quickly as possible. Confinement in a dark room is advisable, and the surroundings should be quiet and sleep should be encouraged. As anæmia frequently exists, ferruginous tonics should be given. The phosphide of zinc with nux vomica forms an excellent preparation. Hypodermic injections of strychnine should be tried, as their action is prompt. At the same time psychical influences should be brought to bear upon the patient. Much can be accomplished in this way. Promise the patient that upon a certain day she will be better on conditions which she must follow out *strictly*. If the surgeon once gains the confidence of the patient, he can accomplish much by influencing the mind. General massage has been used with beneficial effects, and should be tried.

Night-Blindness, Idiopathic.—When the eyes have been exposed for a long time to the intense light of the sun or a brief reflection from water, there ensues a temporary exhaustion of the sensibility of the retina. Persons so exposed are not able to see objects in dim light or twilight, and at night are quite helpless. Soldiers and sailors stationed in the tropics are particularly liable to be thus affected. The disease is often associated with an exhausted condition of the system, scurvy, or insufficient nutrition. It occurs occasionally in what might be properly called an epidemic form, a large number of soldiers and sailors being similarly affected at the same time and from the same

cause. The ophthalmoscopic changes are practically negative. This disease must not be confounded with true retinitis pigmentosa, which comes on very slowly and when the retinal alterations are marked.

The writer saw one case of night-blindness in the person of a railroad engineer whose run was through the plains of Arizona and New Mexico.

The treatment consists of rest in a darkened room and the use of tinted glasses. Quinine and strychnine should be given internally. Fresh vegetables, lime-juice, and lemons, with a generous dietary, should be allowed to those suffering from scurvy. The prognosis is almost without exception favorable.

Snow-Blindness.—Allied to night-blindness is snow-blindness, which is caused by exposure to the intense reflection from snow and ice. Here, however, there seems to be rather hyperæsthesia of the retina with photophobia. The conjunctiva and cornea are often involved. The intense cold and malnutrition are probably important factors in producing this condition.

The eyes should be protected from bright light and tinted shades should be worn; cold or warm applications to the lids externally as may be indicated. Cocaine locally should be tried. Corneal and conjunctival complications should be treated according to indications.

Hemianopia or Hemianopsia.—Hemianopsia signifies blindness of one half of the field of vision, and is dependent on some interference with the functions of the optic nerve localized in the optic chiasm or on some serious central lesion of the brain involving the origin of one of the nerves. The defect is symmetrical, and may involve (*a*) the right or the left side of the field of vision (homonymous), (*b*) the temporal side, (*c*) the nasal side. The ophthalmoscope shows no lesion in these cases. In intracranial tumors, however, the progress of the disease may cause atrophy of the optic nerves and total loss of vision.

Some cases are undoubtly syphilitic, due to gumma pressing upon one tractus. In such cases the iodide of potassium should be promptly used in very large doses and pushed rapidly to the utmost limit of tolerance. This will be followed with favorable results in many cases. From the fact that syphilis may have been previously acquired, and yet no symptoms now exist, it may be advisable to try provisionally this therapy in all cases. Some cases are undoubtedly due to hæmorrhage, the extravasated blood pressing on the tractus or chiasm. If there is any shadow of reason to suspect such a condition, ergot should be administered in full doses.

Some rare cases are due to malaria, a serous effusion pressing on the tractus. Haral reports such a case, and a colleague here has seen one. Such cases will respond favorably to quinine in round doses.

DISEASES OF THE LENS, AND GLAUCOMA.

By SWAN M. BURNETT, M. D., Ph. D.

DISEASES OF THE LENS.

Senile Cataract.—Assuming that the diagnosis of cataract has been made early, the management of the case through its course, which may continue for a number of years, is one which calls for not a little skill and tact on the part of the medical attendant. We are alluding now to ordinary senile cataract, which may occur at any time after the forty-fifth year or even earlier.

In the first place, the question arises in every case of incipient cataract, when the time for surgical interference is probably a long way off, Shall the patient be informed of the fact that cataract is present? To the majority of patients it is probably not wise to state it plainly. "Cataract" has a frightening sound to most minds, and it is not well, if it can be avoided, to let the patient suffer so long from the depressing knowledge that sooner or later total blindness must set in. It usually suffices to say that there is some opacity in the lens, such as is common in advancing years, and that it may remain stationary; for it is a fact that many lenticular opacities do remain stationary for a long time, and there can hardly be a doubt that on rare occasions they disappear. These happy eventuations, however, are not to be depended upon, and the rule is for a steady, though it may be a slow, increase in the diminution of sight.

During this time of ripening or maturation of the cataract it is by no means necessary that the patient abstain from the customary use of the eyes; whatever work can be done with comfort should be permitted. Cataract, while undoubtedly, in one sense, the result of malnutrition of the lens, cannot, I think, be regarded wholly in the light of a morbid process. It would really seem to be, in most instances, a natural evolutionary process, and it is probable that most crystalline lenses would become opaque if the individual lived long enough. It is a change which is the accompaniment of senile degeneration and the natural decay of the vital powers. In some cases, however, the opacity is undoubtedly due to an evident pathological condition of the interior of the eye.

In many instances the amount of vision possessed by the cataractous eye can be considerably increased by artificial means. The alterations in the lens usually bring about a change in the static refraction of the eye. This may be either in the form of an increase or of a diminution of the refracting power; that is, there may be a development or an increase of an existing hypermetropia or myopia, or it may manifest itself in the form of an astigmatism.

Cataract patients should therefore be examined from time to time to ascertain whether a change in their glasses may not improve what vision still remains to them.

As a general rule, this refractive change takes the form of hypermetropia, because, usually, the sclerosis of the lens begins in the corticalis, with the effect of more nearly equalizing the density of the lens-tissue as a whole and thus diminishing its total refractive power. At other times the sclerosing process is more pronounced in the nucleus, increasing still further the normal difference between the refractive index of that and the corticalis. Under the latter conditions a myopia is developed, and the patient may no longer need to use the glasses he formerly did for reading or near work. This is the "second sight" which sometimes comes to old people. It is no essential rejuvenescence of the eye, for, though they may see without glasses near at hand, it is at the expense of their distant vision, which, however, can be improved by concave lenses. Moreover, the advantage is commonly of short duration, for with the advance of the sclerosing process the opacity increases and darkness finally sets in.

In some exceptional cases, however, this nuclear sclerosis may remain comparatively stationary for many years, and the patient may die before the cataract is matured, enjoying fairly good vision all the time. I have reported one such instance,[1] in which the patient possessed useful vision for more than thirty years.

When the opacity is principally nuclear and the corticalis is relatively clear, great improvement in vision is obtained by the use of a mydriatic. The dilatation of the pupil allows the light to pass into the eye through the transparent portion around the central opacity, and the increase in the amount of vision thus obtained is sometimes very considerable; in fact, converting what is practically blindness into an ability to get around comfortably and in safety. For this purpose there is probably nothing better than sulphate of atropine. It need not be used in a solution stronger than one grain to the ounce of water. A drop of this solution put into the eye will keep the pupil dilated from two to four days, at the end of which time it can be repeated. A stronger solution, such as four grains to the ounce, will maintain its action for a week or longer. Applied at intervals of a few days, there is

[1] *American Journal of Medical Sciences*, 1873.

really no danger of its producing atropine conjunctivitis or having a toxic effect. Other mydriatics, such as homatropine, hyoscyamine, or daturine, can be used, but none have the advantage of persistent effect that the atropine salts possess. If the bright light of the sun is disagreeable with the dilated pupil, colored glasses—gray or blue—should be worn out of doors. The ciliary muscle being paralyzed by the mydriatic, there is, of course, no accommodation remaining, and for examining objects near at hand a strong convex lens is needed. For such purpose the large round or oblong reading-glasses in the shops are useful. It is well, however, that no great strain should be put upon the eyes, and they should not be used for any great length of time at once, and only under the most favorable conditions of light and position.

No special attention need be given to the general health beyond that called for by a deranged condition of the system. It not infrequently happens that opacities of the lens develop during exhausting diseases, especially diabetes, owing most probably to the altered constitution of the fluids. A marked diminution of these opacities, and even their complete disappearance, have been reported on amelioration of the patient's general condition.

From time to time men have offered methods asserted to produce resolution of lenticular opacities. This has been claimed for electricity, and for a manipulation of the eyeball through the lids after a drop of some emollient solution had been applied, and for applications containing phosphorus. It can be stated very positively that none of these methods can be relied upon, and the general belief among surgeons is that whenever improvement is found during their employment, it is to be referred to the natural course of the disease, which is often very unsteady and fluctuating.

Operative Treatment.—The curative treatment of senile cataract is exclusively operative. The old operation of repression, reclination, or couching, in which the lens was forced, by means of a needle inserted through the sclerotic, from its position behind the iris and pupil downward in the vitreous, was the first method to be generally employed. The fatal defect of that operation as compared with those of modern times is that the dislocated lens does not always remain in the position in which it is placed, but often returns to its former situation behind the pupil, and, moreover, acts as a foreign body in the interior of the eye, liable and likely at any time to cause a painful and destructive inflammation.

To Jacques Daviel of France (1752) belongs the credit of revolutionizing the methods of treating cataracts by extracting them through an incision in the cornea. And in some slightly modified forms it remains the method in universal use to-day, and must be regarded as one among the greatest triumphs of surgery.

The consideration of the technique of the operation belongs more

properly to works on ophthalmic surgery, and all that is needed here is an indication of the general outlines of the procedure.

When a cataract is slow in ripening and there are probably many months if not years of semi-blindness before the patient, the process of maturation can be hastened by making an iridectomy and rubbing the lens through the cornea (Foerster). In some instances the process is so much hastened by this method that extraction can be undertaken in from three to six weeks. Of late years, however, there has been a tendency to operate on immature cataracts much more frequently and at a much earlier period than formerly. It was once the custom to wait until total blindness set in before undertaking extraction, but now some surgeons operate as soon as the patient is unable to get about comfortably. It is only in exceptional circumstances that both eyes should be operated upon at the same time by extraction. If there is any considerable conjunctivitis at the time, it should be subdued before the operation of extraction is undertaken, and the existence of dacryocystitis is almost a contraindication. Some surgeons remove any existing pterygium.

As a general rule, no special preparation of the patient is needed before operation. The bowels should be freely moved on the morning of the operation, and in hospital cases a bath should be taken. Immediately before the operation the face and eyelids, and especially their edges, should be washed off with soap and water, and afterward with an aseptic liquid (mercury bichloride 1 : 5000, or saturated boric-acid solution), and the conjunctival sac freely washed out with the same solution. The eye is then rendered insensible with a 4 per cent. cocaine solution.

The operation of extraction is usually performed as follows: The eyelids are held apart by means of a speculum or by the fingers of an assistant, and, the conjunctiva being seized by the fixation-forceps at a point just below the vertical meridian of the cornea, a narrow knife, devised by Von Graefe, is introduced at the juncture of the clear cornea with the sclerotic at a point where the upper joins the middle third of the circumference of the cornea, making a base of about 12 mm. After the puncture the knife is carried across the anterior chamber and a counter-puncture effected at a corresponding point on the other side, and by two or three to-and-fro movements of the knife the upper third of the cornea is detached. The apex of the corneal flap should lie somewhat more in the cornea than its base. If it is designed to do the "combined operation," as it is called, an iridectomy is now made. The capsule of the lens is then divided by a cystotome, and the lens forced out by pressure, exerted by a rubber spoon or other means, at the lower corneo-scleral junction, at first backward until the lens is engaged in the wound, and then upward until it is delivered. The eye is then cleared of all

remaining soft cortical substance by gently rubbing on the cornea from below upward, or by washing out the anterior chamber with an aseptic solution by means of a syringe specially devised for that purpose. If the extraction is to be made without an iridectomy, as soon as the incision is completed the capsule is divided and the lens pressed out through the intact pupil. Should the iris, which is partially pushed out with the exit of the lens, not return of itself, it is gently replaced by rubbing with the finger over the closed lids, or by means of a delicate spatula introduced into the wound, and a drop of a 2 per cent. eserine solution applied to ensure and maintain contraction of the pupil. Should the iris show a marked tendency to prolapse, it is better to cut it off at once, thus converting the simple into the combined method.

The *after-treatment* of cataract extraction is usually very simple. After the anterior chamber is cleared of all débris and the iris is in proper position, and the edges of the wound well coapted, the lids are closed and covered with a bit of soft cotton cloth saturated with an antiseptic solution. The hollow of the orbital cavity is then filled with absorbent cotton and a bandage applied. The patient is then placed in bed, if the operation have not been performed there, as is my custom when possible, and quiet, in a recumbent posture, enjoined for forty-eight hours. Greater liberty should be allowed aged and feeble persons, for in these the prolonged position on the back has been known to bring about a hypostatic pneumonia. Dark rooms are not only unnecessary, but positively harmful. If there is no complaint on the part of the patient, the bandage need not be changed for forty-eight hours. It should be removed at the end of that time, and, if the lids are not markedly swollen and the discharge on the dressing is not distinctly purulent, the eye should not be inspected. The lids should be washed with an antiseptic liquid and fresh dressings applied. At the end of the third day the lower lid may be pulled down and a drop of atropine solution, 4 grains to the ounce of water, put in, and the bandage limited to the eye operated upon. If all goes well the bandage may be removed during the daytime from this eye after the fourth or sixth day, being reapplied at night for protection against injury.

Suppuration of the flap, with a consequent pan-ophthalmitis, which was formerly so much dreaded, has now ceased to exist under proper antiseptic precautions before and during operation, but iritis of a severe and dangerous character may occur. This usually develops on the fourth or fifth day after the operation, but may occur on the second day, and I have seen it postponed to the ninth. It is to be combated by local bloodletting in strong patients and by atropine and hot fomentations.

The bandage can usually be replaced by a shade on the eighth or tenth day in cases of normal healing, and the patient allowed to go out at the end of two weeks. There are some who allow much greater

freedom than that here indicated, but in my opinion it is not good surgery. Examination for glasses can be made at this time in cases which have run a normal course, but on account of the astigmatism which usually exists at this early date the glasses found to be most suitable are not those which will be permanently required. The eye usually settles down to its definite optical state within three months.

In a certain proportion of cases the capsule is thickened and more or less opaque, and a secondary operation becomes necessary for the best vision. This consists in dividing the capsule with a Von Graefe knife or a knife or scissors specially constructed for this purpose.

Traumatic Cataract.—The management of cases of traumatic cataract will depend upon many attendant circumstances, such as the character of the injury, its extent, the age of the patient, etc. That limited opacities of the lens caused by traumatism may disappear is, I think, beyond question, but the almost invariable rule is for such opacities as are caused by a rent in the capsule that is at all extensive to increase until the whole lens becomes opaque. The process may last for many months, but the opacification finally becomes complete. In most instances it goes on with swelling of the lens from imbibition of the aqueous humor through the rent in the capsule, and, if the patient is young, to complete absorption of the lens substance. It is the consequences of this swelling of the lens that require the careful attention of the surgeon. If the patient be young, a very considerable amount of swelling may do no harm, but in persons beyond thirty years it must be closely watched for the appearance of iritis or glaucomatous symptoms.

The first step in the treatment consists in getting a good dilatation of the pupil and in maintaining it. An atropine solution, 4 grains to the ounce, should be used twice or three times a day, and the eye protected by a shade or colored glasses. Should signs of inflammation set in, and particularly if they are accompanied by increased tension of the ball, the lens should be extracted. It will generally be best to make an iridectomy at the same time if the patient is not young or if the iris has been injured.

If the lens matter is very soft, it can generally be evacuated through a linear incision made in the cornea with a triangular knife. If the process of absorption is slow or remains stationary for a time, it can be hastened by enlarging the opening in the capsule with a needle and breaking up the lens still more, so as to allow of more rapid disintegration and absorption by the aqueous humor.

Congenital Cataract.—Under this head may also be considered the treatment of congenital cataracts of children and all *soft cataracts* occurring in young persons. Formerly discission or solution of the lens was practised in all cataracts found in persons under thirty years of age. The process was slow, it is true, taking, in those over fifteen years

of age, several months to complete it, but then extraction was not so successful an operation as it is now with our more perfect methods and complete asepsis. The majority of cataracts in those above twenty-five years of age should be extracted.

Zonular Cataract.—Cases of zonular or *lamellar cataract*, in which only a few layers of the lens are opaque, with a quantity of clear substance in the periphery, and which are congenital, can be treated either with a small iridectomy, which uncovers the transparent portion, or by an iritomy, which accomplishes the same purpose. This latter is done by means of a pair of scissors, preferably the *pince ciseaux* of De Wecker, introduced into the anterior chamber through a corneal incision, and inserting one blade under the edge of the pupil and cutting through the iris. On account of the danger of wounding the lens in this operation the small iridectomy is to be preferred. These cases commonly go on to complete opacification of the lens in later life, and then discission or extraction is the proper method.

Anterior and posterior *polar cataracts*, which are usually on the capsule and small, had better be left alone.

Dislocation of the Lens.—Lenses dislocated into the aqueous or vitreous chambers present very serious problems for the surgeon. When the lens is removed from its proper position, it becomes from a surgical point of view a foreign body, and, though it may remain without exciting any irritation for a number of years, it is liable at any time to be placed by a blow or even a sharp concussion of the body where dangerous if not destructive inflammation will follow.

It not infrequently happens that it passes through the pupil from the vitreous into the anterior chamber, or may lie in the pupil itself. In some instances it may be advisable to try to cause the absorption of such lenses by discission, but the general operation must be extraction. This is, from the nature of the circumstance, a difficult operation, the great danger being, of course, the escape of vitreous. The vitreous is fluid in most cases, and always so where the dislocation is spontaneous or the lens is hypermature. When the eye is opened under these circumstances there is nothing to prevent the outflow of the liquid vitreous, often leaving the lens behind.

Dr. Agnew of New York devised a double needle or bident, which he inserted in the sclerotic behind the lens, and, pushing it forward against the cornea, held it there by transfixing the sclera on the other side while the incision was being made. The lens was then pressed out and the bident withdrawn. Few surgeons have adopted this procedure, though I myself have used it two or three times with moderate satisfaction. The method I have employed with success is to have the upper lid held up by an assistant, and, holding the eye with the fixation-forceps as in an ordinary extraction, make the puncture and

counter-puncture in the usual way. As soon as this is done pressure is made on the ball directly backward with the fixation-forceps. A gush of vitreous then usually takes place by the side of the knife, and the lens is thrown forward against the pupil. The section is then continued under this steady pressure backward, and on its completion the lens is thrown out with another gush of vitreous. The upper lid is dropped at once and the eye bandaged. The case is then treated as an ordinary extraction. Lenses only partially dislocated so long as they remain transparent should not be disturbed. They give rise to ametropia, usually astigmatism, which can be treated by optical means.

GLAUCOMA.

UNDER the name "glaucoma" there is associated a group of symptoms, most, if not all, of which are to be referred to an abnormal increase of intra-ocular tension. These are: dilatation of the pupil; shallowness of the anterior chamber; haziness of the cornea; decrease of visual acuteness; restriction of the field of vision; appearance of halos around points of light; more or less pain in the eye and head; cupping or excavation of the optic papilla, which may or may not be atrophied to a greater or less extent; and spontaneous pulsation of the retinal artery. There may or may not be inflammatory appearances in the external tunics, and in any individual case one or more of the above-mentioned symptoms may be absent. For the purposes of study —and, to some extent, for therapeutics also—it has been divided into acute, subacute, and chronic, and primary and secondary. The subdivisions of these primary divisions are—glaucoma fulminans, glaucoma absolutum, glaucoma hæmorrhagica, terms which hardly need explanation. As much has been written upon the pathology of glaucoma perhaps as upon any other one disease of the eye, and yet we have no really positive knowledge regarding its essence. We are unsettled in opinion as to whether it is nervous or inflammatory in its origin, whether it is due to an excess of secretion, over-excretion, or to a diminution in the excretion of the intra-ocular fluids.

The scope of this article does not allow us to enter into a study of these questions, and moreover they have only an indirect influence on our therapeutics, which is, almost wholly, empirical. The discovery of our principal remedy against the disease, iridectomy, was hardly more than a happy accident. Von Graefe observed that an iridectomy made in certain affections with increased hardness of the ball diminished the tension, and, finding that in glaucoma the leading symptom was increased tension, made an application of the remedy, and thus discovered the first reliable therapeutics for a disease which had hitherto

been deemed incurable. But the manner in which it operates is not understood. Some hold that it is not the section of the iris alone which gives the result, for in order to secure a certain success for the operation the incision must be made very peripherally behind the clear portion of the cornea; in fact, in the sclera. The advocates of this theory explain the result by the opening up of a filtration-way outward for the increased intra-ocular secretion, and for them the sclerotomy is the important thing. This cannot be wholly true, however, for the beneficial results are seen just as well when the incision is perfectly healed as when there is a remaining cystoid cicatrix. The majority of the best authorities do not rely upon sclerotomy as they do upon iridectomy, which in certain forms of the disease is the sheet-anchor. With the exception of cataract-extraction the making of an iridectomy in acute glaucoma is the most brilliant in its results of any operation in ophthalmic surgery. An eye which is certainly doomed to destruction is saved.

PROPHYLAXIS.—To come to a more detailed and immediate study of the management of glucoma, we shall premise a few observations on prophylaxis. In those who have already suffered from glaucoma or are known to be predisposed to it certain precautionary measures are to be insisted upon. The majority of such eyes are either hypermetropic or astigmatic, or both, and the full correction of the ametropia should be made and the glasses worn constantly. The eye should never be subjected to any strain, and should be used as little by artificial light as possible, and, as there is undoubtedly a nervous element in the causation, all strong emotional excitement should be avoided. When a patient comes with an eye red and suffused, with the lids thickened and some chemosis of the conjunctiva, a copious flow of tears, and an intense neuralgic pain in the head and eyes, it would be a serious error to make the diagnosis of iritis at first sight, and give the atropine solution which would be pertinent and proper to it. The condition of the pupil and the tension of the ball must both be examined into, and if the pupil is found dilated and the tension increased, all mydriatics must be avoided. The instillation of a single drop of an atropine solution has been known to develop an attack in a person predisposed to the disease. An eye with a tendency toward glaucoma has its greatest enemy in a mydriatic, and for that reason we should always be careful in ordering atropine for an uninflamed eye, in examining for refraction, for instance, in persons who are over forty years of age. Cocaine, however, is a mydriatic which does not increase, but on the other hand diminishes, intra-ocular tension.

IRIDECTOMY.—Having once established the diagnosis of acute inflammatory glaucoma, there is only one thing to be done, and that is iridectomy, and with as little delay as possible. But it may be that circumstances

are such that an immediate operation is not possible. The attack may be slight, like many others the patient has had, and there may be an unwillingness to submit to the operation and the mutilation until the danger is felt to be more immediate, or from other reasons the operation may not be feasible. The purpose then should be to endeavor to cut short the attack and place the patient in as comfortable a condition as possible. The first thing to be done under these circumstances is to get contraction of the pupil, and for this nothing is better than sulphate of eserine. To accomplish this a solution of 2 or 3 grains to the ounce may be used, putting a drop in every three or four hours until the pupil responds. The effect can then usually be kept up by a weaker solution, say 1 grain to the ounce. If there are considerable inflammatory symptoms, leeches should be applied to the temple, and a general antiphlogistic regimen adopted if the patient is strong enough, and the pain relieved by morphine and hot applications to the eye. If morphine is given internally, it is well to combine it with quinine. These, however, are only temporary measures, and are simply to keep the disease in check until an iridectomy can be done.

The making of an iridectomy in glaucoma is more difficult than one done on ordinary occasions. The anterior chamber is always shallow, sometimes entirely abolished, and the iris is frequently restricted to a rim so narrow as to be seen with difficulty under the conjunctival chemosis. The incision must be as peripheral as possible, lying wholly in the sclera, and the section of the iris should be as broad as possible. The incision can be made with the usual triangular iridectomy-knife or with a Von Graefe cataract-knife, some claiming that the latter has an advantage when the chamber is very shallow. The principal danger of the operation is the wounding of the capsule of the lens.

The *after-treatment* is the same as in other operations in which the eyeball is opened. Rest, though not necessarily in bed, bandaging, and the eserine treatment must be continued to keep the pupil in as contracted a state as possible. The eserine should not, however, be pushed too far, because of the danger of producing iritis. After the iridectomy is made, there is less danger in using atropine, and sometimes it is called for if iritis should set in.

Other myotics besides eserine may be used—as pilocarpine, 2 to 4 grains to the ounce; muscarine, 2 to 4 grains to the ounce—but none of them are so reliable as the eserine. In the subacute form, where the process is not so active and the inflammatory symptoms are not so marked, the tentative and expectant treatment may continue longer, and undoubtedly in some cases the disease-process seems to be held permanently in check; but, as in the acute form, an iridectomy is the only therapeutic measure upon which to lean confidently.

Chronic Glaucoma.

When it comes, however, to the chronic form without inflammation, the *chronic simple glaucoma*, the case is quite different. We are here dealing with a set of conditions which are in several ways quite distinct from the acute and subacute forms. What is now called "chronic simple glaucoma" was called by Von Graefe "atrophy with excavation," and evidently in his mind was doubtfully classed with glaucoma. There is seldom any marked increase of tension, and an almost entire absence of inflammatory symptoms, though occasionally a pronounced acute attack develops in such eyes. It is certain, however, that the means which we employ with such success in the acute and subacute forms avail here in a small minority of cases only.

The process seems to stop of itself in some rare instances at a certain stage, and progresses no farther, though usually blindness is at the end. The consensus of opinion among the best authorities seems to be in favor of doing an iridectomy. Some few prefer a sclerotomy. In doing either we shall at least have the satisfaction of doing all that can be done. It must be said, however, that in not a few cases the disease seems to make more rapid progress after the iridectomy.

A systematic use of eserine or pilocarpine in a very weak solution, $\frac{1}{8}$ or $\frac{1}{4}$ of a grain to the ounce of water, once a day or every other day, is thought by some to hold the symptoms of the disease in abeyance. If an operation is not decided upon, this method of treatment should be tried. In such cases it is well, too, to try strychnine as a tonic, for there are those who believe that the primary process is one of atrophy of the nerve. As a substitute for iridectomy sclerotomy has been suggested and tried. The usual way of performing this latter is to make the puncture and counter-puncture with a Von Graefe knife, as in the operation for extraction of cataract, but as far back in the sclera as possible; then just before completing the section to withdraw the knife, leaving a bridge of sclera at the apex. This helps to prevent the prolapse of the iris. Sclerotomy is also sometimes done after an iridectomy has been made which failed to check the morbid process. In some cases it may be advisable to make a second iridectomy, particularly in the subacute cases.

The attempt to establish a permanent filtration by means of a gold or silver wire or catgut inserted in the sclera need be mentioned only as showing the expedients to which ingenious men have been driven to find a remedy for this disease.

In glaucoma absolutum, where vision is gone and the eye is painful, enucleation is the best remedy. A degenerated glaucomatous eye is always a source of trouble, and the patient is much better without it. If enucleation is denied, then an iridectomy may be done to give relief

from pain and place the eye in a more favorable general condition. In some cases, when the eye is too much inflamed to attempt enucleation, puncture of the sclera often gives relief to the tension and pain. Stretching of the infratrochlear nerve (Badal) has been resorted to for the relief of pain, and it is also claimed that it exerts a favorable impression on the course of the disease.

In secondary glaucoma—that is, when glaucomatous symptoms supervene on other inflammatory diseases, such as iritis, intra-ocular hæmorrhage, tumors, etc.—the same general lines of treatment hold good as in the primary forms. If vision is lost, such eyes had better be removed at once. In lost glaucomatous eyes, primary or secondary, neurectomy of the optic nerve may be done for the relief of pain. In many cases, however, the relief is not permanent, and except for some special reason enucleation is to be preferred.

DISEASES OF THE ORBIT, LACHRYMAL APPARATUS, AND EYELIDS.

By HENRY GRADLE, M. D.

DISEASES OF THE ORBIT.

Affections of the orbit are not common; they occur in about 0.2 per cent. of the patients in average ophthalmic practice. Most of these diseases involve, however, quite a serious danger to the integrity of the eyeball or even to life.

On account of the comparative inaccessibility of the orbit the differential diagnosis of its diseases is often a matter of difficulty. Certain symptoms are more or less common to all orbital anomalies, and by discussing these under one head unnecessary repetition can be avoided.

Exophthalmos, the protrusion of the eyeball, is the result of any morbid process which augments the bulk of the orbital contents. It is only when an orbital tumefaction is situated in front of the centre of the eyeball (in the tear-gland or at the orbital rim) that it would fail to push the eyeball forward.

Enophthalmos.—The reverse condition, receding of the eyeball into the orbit, enophthalmos, is apparently produced by any condition of emaciation or extreme anæmia. The appearance of the sunken eye of wasting diseases is, however, due more to the absorption of fat in the front part of the orbit under the lids than in the retro-ocular tissues. Occasionally retraction of the eyeball occurs in consequence of cicatricial shrinkage after orbital cellulitis.

The increase in the bulk of the orbital contents which leads to exophthalmos is not necessarily uniformly distributed.

If the new formation is at all excentric the eyeball is displaced laterally as well as pushed forward. Any process sufficient to displace the eyeball interferes usually with its movements, either mechanically or by involvement of the muscles in the disease. In consequence double sight, diplopia, results, the displacement of the images varying of course with the muscles involved.

The vascular phenomena on the skin and conjunctiva vary with the extent and character of the morbid process in the orbit. Acute inflammations of the deeper parts are accompanied by active congestion of the

surfaces, while mere increase in bulk of the orbital contents may cause more or less venous stasis. The greater the vascular disturbance, the more apt it is to be associated with lymph-stasis, appearing as simple œdema of the skin, but in the conjunctiva as inflammatory œdema, chemosis. Congestion and œdema may be either diffused or localized according to the extent of the morbid process.

The pain of orbital diseases varies with their nature. It is generally acute in inflammations and often associated with one-sided headache. Growths of the orbit cause either no pain at all when stationary or growing slowly, or give rise to irregular neuralgia if they either involve or press on the ciliary nerves.

Orbital diseases do not primarily interfere with sight, but most of them endanger the eye, for later on a suppurative process may spread to the eyeball or it may be followed by optic atrophy due to cicatricial contraction. On the other hand, the pressure of orbital growths may damage the nutrition of the eye through interference with the circulation, or even destroy sight directly by compression of the optic nerve.

Disease of the orbit may menace not merely sight, but even life. Yet the probability of suppurative processes spreading through the thin long plates or any of the fissures to the cranial cavity is not as great as the anatomical conditions seem to suggest, although such accidents have been recorded. More serious than suppurative processes are malignant tumors. It is general surgical experience that the danger of relapse after operations for malignant growth from the orbit, and the possibility of subsequent invasion of the brain, are greatly lessened by complete removal of the orbital periosteum. But there are also other channels through which neoplasms may reach the brain, particularly through the space between the sheaths of the optic nerve.

Periostitis of the orbit appears as an acute inflammatory disease. If localized, as it often is, and situated near the rim of the orbit, its site can be ascertained by the finger. The tumefaction may assume later on such extent and present such hardness as to make the diagnosis quite obscure. The disease usually lasts many weeks or months. There exists a syphilitic form of periostitis of the orbit which can generally be removed without death of the bone by vigorous specific treatment.

Most commonly, however, periostitis is due to infection by either tubercle bacilli or one of the ordinary forms of pus-microbes. The tubercular form is more common in children than in adults. These varieties of the disease always proceed to the suppurative stage, and will often lead to localized necrosis or caries of the orbital wall. As soon as the tumefaction suggests the presence of pus, it is best to explore for it with a stout needle. The pus should then be evacuated by an incision guided by a thorough anatomical knowledge.

In view of the importance of the surrounding tissues all operative work should be done under the utmost aseptic conditions.

As a rule, the pus can be reached by the shortest route by an incision through the conjunctiva. Since the mucous membrane cannot be kept aseptic, infection of the wound must be prevented by introducing iodoform into it. If pus is found, the surgeon should then probe for dead bone, indicative of caries or necrosis of the orbital walls. But unless a sequestrum is found detached it is generally not the better plan to attempt to remove it, on account of the danger of wounding the adjoining structures. By maintaining drainage for the pus and combating the infection by means of iodoform suspensions injected into the fistula, we can prevent further damage and can safely wait for either spontaneous repair of the carious bone or the complete loosening of the sequestrum. In some instances, however, especially where the caries affects the rim of the orbit, it may be the speedier plan to use the curette.

Caries of the orbital rim is apt to lead to ectropion on account of the cicatricial contraction of fistulous tracts. In such cases the best results can be obtained by deferring any ectropion operation until the disease has been completely healed for at least a number of weeks. Should the ectropion be so extensive that the eyeball needs protection, it may be best to temporize by shortening the lid aperture by means of tarsorrhaphy.

Orbital Cellulitis or **Phlegmon** of the orbital cellular tissue can usually be distinguished from orbital periostitis by reason of the diffuseness of the inflammatory process and the absence of any localized tumefaction. Occasionally, although rarely, instances are met with which present all the appearances of inflammation of the orbital cellular tissue, but end in resolution within a few days. In most cases, however, the disease terminates in suppuration and heals only after the pus can find sufficient vent.

Orbital cellulitis may be of traumatic origin. It has been caused by perforation of the lachrymal sac by forcible probing, the infective material being conveyed by the probe or coming from the purulent contents of the diseased sac. In other instances the disease is a manifestation of a pyæmic condition. It may also follow facial erysipelas or carbuncles of the face, in which case the infection proceeds along the veins.

Phlebitis of the orbital vein may terminate fatally by extending to the cavernous sinus. More often, however, the course of venous infection is the reverse. A phlebitis of the cavernous sinus spreads downward and invades the orbits, almost invariably both at the same time. The diagnosis of this precarious condition depends on the coexistence of cerebral symptoms with the usual indications of orbital inflammation.

No medicinal treatment is known that could exert any specific influence in orbital cellulitis. Hot applications may soothe the pain and hasten the occurrence of suppuration. As soon as the latter can be recognized surgical means are of course indicated.

Inflammation of the Capsule of the Eyeball or Sheath of Tenon, or **Tenonitis Capsulitis,** can sometimes be recognized as an inflammation distinct from the diffuse phlegmon of the orbital cellular tissue. The inflammation is limited to the immediate vicinity of the eyeball, being sometimes localized only on one side. Suppuration apparently confined to the sheath of Tenon has been known to follow strabismus operations, particularly muscular advancement.

In some instances the disease seems to be of rheumatic origin. Comparatively frequent instances of both the non-suppurative and suppurative forms of tenonitis have lately been recorded as a consequence of influenza. The non-suppurative form is of uncertain duration. In some cases its course seems to be influenced by the use of salicylate of sodium, while other cases prove refractory to all treatment. If suppuration occurs it must be treated on the usual surgical principles.

Hæmorrhage into the Orbit is most commonly of traumatic origin. If caused by blunt force, it is of grave significance, since it is usually, though not invariably, indicative of fracture of the skull. Non-traumatic hæmorrhage is very rare, but has been observed in scurvy and degenerative condition of the blood-vessels, and exceptionally as the result of severe efforts like coughing.

The diagnosis of hæmorrhage depends on the sudden occurrence of effusion into the orbit, usually with bloody infiltration of the conjunctiva, sometimes of the lids.

Copious hæmorrhage may lead to serious consequences by compression of the optic nerve and vessels of the eye.

The continuance of the hæmorrhage may be held in check by a compressive bandage. Its reabsorption cannot be hastened except, perhaps, by massage or the internal use of pilocarpine.

Emphysema of the Orbit may result from fractures of the floor or internal wall of the orbit, whereby air can be forced from the nose into the orbital cellular tissue. The peculiarities of gaseous infiltration of the tissues and conjunctiva are unmistakable. If the patient abstains from all violent expiratory efforts the air in the cellular tissue is soon reabsorbed.

Tumors of the Orbit, although not frequent, may occur in great variety. Instances of almost all known types of neoplasms have been observed in the orbit. They may originate from the nerves or the muscles of the eye, from the periosteum or bony walls, from the tear-gland, from the orbital cellular tissue or blood-vessels, or from the eyeball

itself, or grow inward from the skin. The diagnosis of the nature of a tumor is necessarily difficult.

The history of the growth as well as the general history of the patient must be carefully compared with all that can be ascertained regarding the new formation by sight and touch. Its site, mobility or attachments, softness or hardness, fluctuation (often very obscure) or compressibility, must form the basis of our judgment; which may also be aided by an exploratory puncture.

Carcinoma and **Sarcoma** are the most serious of all orbital tumors and require complete extirpation. If they are not strictly localized and circumscribed, it is safer, indeed, to remove all the contents of the orbital cavity, including the periosteum. On the other hand, non-malignant growths need removal only if by reason of their size they cause annoyance or if their history indicates further tendency to grow. In the removal of a non-malignant tumor all efforts should be made to spare the eyeball, even if sightless, and certainly if functionally intact. But as this operation may not prove feasible, the patient's consent to sacrifice the eye, if necessary, should be obtained beforehand.

Cysts are the least harmful of any tumors. If they require excision on account of their size, the complete sac should be removed. In the case of the echinococcus and cysticercus cysts (both very rare) thorough evacuation of the cyst is sufficient.

Hernia of the Brain, or **Encephalocele**, a protrusion of a sac of meninges through the upper wall of the orbit, resembles a cyst, but may be distinguished by its compressibility and the occurrence of cerebral symptoms on compression. This rare lesion is always congenital, and usually destroys life at an early period. No satisfactory treatment has yet heen devised.

Bony Tumors starting from the orbital walls offer often great difficulties to the operator on account of their hardness. The radical operation is hence very dangerous. Their only danger to life lies in the possibility of growing into the cranial cavity, and this event cannot be avoided by an operation. Hence if the pain due to the crowding of the orbital contents requires relief, it is often better to enucleate the eye rather than to attack the osteoma.

Vascular Tumors can sometimes be recognized by their extension into the lid. They are characterized by compressibility, as well as inversely by their turgescence during forcible expiration or from low position of the head. A cure can usually be effected by electrolysis through needles plunged into the tumor. If this does not succeed, extirpation must be resorted to if they continue to grow. The frequent existence of a capsule renders the extirpation less bloody than might be expected.

Pulsating Exophthalmos is a very characteristic morbid condition of the orbit in which the eyeball is pushed forward by compressible vascular tissue behind it, the pulsations of which can be felt by the finger placed on the lid. The pulsating movement may even be visible, while a purring noise can usually be heard on auscultation or by the patient himself. The lesion, even if not traumatic in origin, generally begins rather suddenly, as if a vessel had burst. Once begun, the exophthalmos may continue its growth. Various lesions have been found at autopsies as the cause of these symptoms. Sometimes it was a true or false aneurism of the ophthalmic artery; in other instances a false aneurism caused by a rent in the carotid artery inside the cavernous sinus; again, an artero-venous aneurism of the orbit, or simply a bunch of varicose veins. Rarely these symptoms are simulated by an unusually vascular malignant tumor. The affection is a very serious one, as apart from the disfigurement it causes much local discomfort and often persistent vertigo. The eyeball is very apt to suffer from either corneal complications or neuritis and atrophy of the optic nerve. There is, however, scarcely any direct danger to life. Spontaneous recovery, while not unknown, is a very rare event.

The most efficacious treatment of an aneurismal condition in the orbit or intracranial cavity is the reduction of the blood-supply through the carotid artery. Compression of the common carotid should first be resorted to. In some instances all symptoms cease during carotid compression; in others their intensity is merely diminished more or less. The more apparent the immediate effect, the better is the prospect of accomplishing a cure by compression of the carotid artery with the fingers or some form of tourniquet-like instrument. The compression need not be continuous, except in traumatic cases. The proportion of cases actually cured by compression is, however, very small.

If a few days' trial with this method leads to no permanent improvement, nothing less than ligation of the common carotid artery can be depended upon. After the ligature the symptoms diminish at once or very rapidly, and in three to four weeks, at the most, the normal condition of the orbit has been re-established. Of 56 cases of pulsating exophthalmos collected by Sattler,[1] ligature of the common carotid cured 37 patients. In 11 the treatment failed, and 8 died in consequence. As most of these cases date back to pre-antiseptic days, the mortality might be expected to be much smaller with antiseptic operation. Electrolysis of the pulsatile tumor by means of inserted needles has not given many satisfactory results, but may be considered at least devoid of danger. On the other hand, injections of iron salts and other astringents, although a few successful cases have been reported, cannot

[1] *Graefe-Saemisch Handbuch des Augenheilkunde*, vol. vi., where the literature up to 1880 can be found.

but be considered a very dangerous procedure, especially if the injection happens to strike a vein. Injections of ergotin in the vicinity of the tumor have cured only one case, but failed in four others in which they were tried.

DISEASES OF THE LACHRYMAL APPARATUS.

Diseases of the Lachrymal Gland.

The lachrymal gland is not often the seat of disease.

Acute Inflammation has been observed, revealing itself by pain and tenderness and inflammatory swelling at the outer upper corner of the orbit, with protrusion of the gland under the conjunctiva. As soon as the presence of pus can be determined it should be allowed to escape.

Subacute Inflammation of the Tear-gland, not of a suppurative character, has been seen in connection with mumps of the salivary glands, but also without it. It is apt to be very persistent, lasting for months, but ultimately disappearing without residue. No treatment is known to influence its course.

Tumors of the Tear-gland show themselves by protrusion of a more or less hard swelling under the conjunctiva outward and above the eyeball. They may be carcinoma, sarcoma, adenoma, or fibroma. As their nature cannot be recognized clinically, every tumor of the lachrymal gland which is not plainly an inflammatory swelling requires extirpation of the gland.

Dacryops is a rare tumor under the conjunctiva, resulting from the cystic dilatation of one of the excretory ducts of the lachrymal gland. Its fluid contents can be squeezed out. It can be cured by removal of part of the cyst-wall.

Diseases of the Lachrymal Passages.

Strictures.—The calibre of the lachrymal passages is narrowed whenever any part of their wall is either thickened or retracted by interstitial shrinkage. As the result of these changes the passage can no longer carry off the tears. This accumulation of tears in the internal corner of the eye and overflow over the face is known as epiphora.

The tears, however, are not normally secreted in sufficient quantity to require a draining channel except when the eye is irritated—for instance, by wind or dust or during the act of crying. Hence impermeability of the tear-duct does not necessarily lead to constant overflow of tears over the face. Clinically, however, we find that those causes

which are responsible for the disease of the tear-passage also suffice to keep the eye in an irritated condition in many instances. Thus chronic conjunctivitis or nasal disease may lead not only to insufficiency of the tear-duct, but may by their presence maintain a more or less continuous flow of tears. Watering of the eye due to lachrymal stricture is hence either an occasional or an almost continuous annoyance.

Obstruction of the lachrymal passages may in some instances give rise to no complaint beyond the annoyance caused by the overflow of tears. Most of the patients, however, suffer from more or less burning and smarting and inability to use the eyes continuously. The disease is also likely to lead to complications. Very commonly blepharitis and chronic conjunctivitis are maintained by the irritation due to the constant presence of tears. It is also not rare to see an occasional acute erythema of the skin of the lids sometimes prolonged into a chronic form.

While obstruction of the tear-duct (without suppuration) cannot be considered a direct cause of corneal disease, it is often observed that corneal inflammations, incidentally acquired, are particularly persistent in cases of epiphora.

The diagnosis of lachrymal stricture cannot be based alone on the patient's statement that the eye waters. For a flow of tears too copious to be carried off by a normal duct may be kept up by any irritant disease, acute or chronic, of the eye, eyelids, or nose. It is not uncommon to find some of these conditions coexisting with lachrymal obstruction. Whenever we can learn that the tears, although overflowing, find their way partly into the nose, a stricture can be excluded. When the evidence is not clear on this question, the history as to whether the watering preceded the other complaints may assist in arriving at a diagnosis.

In order to confirm the diagnosis we must then proceed to probe the lachrymal duct. The method of probing will be described under the head of Treatment.

In the case of obstructed lachrymal passage the probe will encounter an obstacle—either 1, in the canaliculus, 2, at the junction of the canaliculus with the lachrymal sac, or 3, toward the nasal end of the sac. The stricture if in the canaliculus is generally only relative and not an absolute closure. In the other places the obstruction is often absolute. The nature of the strictures has been but little investigated anatomically. As far as can be judged from the clinical and scant pathological evidence it is either an inflammatory thickening of the mucous membrane or in the more obstinate cases a cicatricial sclerosis of the connective-tissue wall.

Ulceration, especially syphilitic, lupus, or tumors in the nose may lead to partial obliteration of the duct by adhesion of its walls. This

may also result from injury due to previous careless probing. In a few instances lime concretions and occasionally masses of fungi have been found in the duct.

The causes which commonly lead to lachrymal strictures are catarrhal, follicular, or trachomatous disease of the conjunctiva, and, perhaps even more frequently disease of the nasal mucous membrane extending upward through the nasal duct. In those cases in which no cause can be ascertained at the time of examination, the lachrymal affection originated from some inflammatory condition of the conjunctival or nasal membrane which may by itself have disappeared, while the lesion in the narrow lachrymal passage persists.

For exploratory or curative purposes the lachrymal passages may be entered without the use of a knife if the punctum is sufficiently large to admit the fine point of a conical stylet, which introduced as far as possible dilates the end of the canaliculus so as to permit the easy entrance of the blunt probe.

The moderate pain can be somewhat diminished by previously holding a minute pledget saturated with 10 per cent. cocaine solution against the punctum. If the stylet cannot enter the narrow punctum, or if its use be too painful, the fine blunt-pointed canaliculus knife must be introduced and pushed toward the nose until it enters the sac. The canaliculus is thus converted into an open gutter without damage to its function. It is not best to cut open the sac itself, except in case of firm stricture at the junction of sac and canaliculus. The probes introduced by Bowman in the form of (double) blunt cylindrical stylets, ranging from Nos. 1 to 8 and known as Bowman's probes (silver), answer for all practical purposes. None of the modifications advocated by other authors possess any material advantage over them. Catgut probes (violin strings E to D) may be more convenient for the patient's personal use, if circumstances require it. The end should be cut obliquely and softened by momentary moistening. It is indifferent whether we enter through the upper or lower canaliculus. The skin of the lid is pulled outward by the thumb until tense, and the probe is inserted into the dilated lower punctum downward (into the upper one upward), and then immediately turned horizontally and insinuated without blind force until it has entered the lachrymal sac and touches its internal wall. It is then, and not before, turned approximately vertical and made to pass down the whole length of the duct. The wider the nose is relatively at the level of its floor, the more the direction of the duct slants outward, while with a very narrow nose and unusual lateral separation of the orbits the duct may even trend slightly inward. Besides, the lower end of the duct is usually a trifle posterior to the sac. Where the upper orbital rim projects markedly the probe should be bent slightly concave. A resistance to the probe

is not necessarily a stricture; it may be a prominence of one of the walls or a temporary swelling of the mucous membrane.

In the normal passage probing causes no sharp pain, and a probe No. 1 while firmly grasped enters without striking any obstacle that gentle rotation will not overcome. It is not always best to persist in forcing the probe in to its full length if much resistance is felt. Sometimes a temporary swelling will subside in a couple of days, and unnecessary pain can thus be avoided. If probe No. 1 cannot pass a stricture without undue force, it is preferable to insinuate a canaliculus knife with the finest blunt point, and to divide the constriction.

The prognosis, and with it the plan of treatment, depend on the narrowness and the nature of the constriction. A slight thickening of the walls of the canaliculus may be cured in a single sitting, while cicatricial constrictions of the sac or nasal duct may require several months' treatment, with introduction of the probe at first three times, and later once, a week. The probe is supposed to act by causing absorption, and is usually left in from ten to fifteen minutes. With a constriction originally slight the size of probe No. 2 need not be exceeded. In more obstinate cases Nos. 4 to 6 should be reached. Thicker numbers are of questionable benefit.

The time of individual sittings and the number requisite for a cure are very materially diminished by connecting the probe with the *negative* wire of a constant battery (from 4 to 8 cells), as shown by Buffum,[1] and independently of him by Jessop and Steavenson.[2]

The passage of a current of three to four milliampères during one to three minutes causes such a relaxation of the constriction that the probe, no matter how firmly grasped at first, can be withdrawn with ease. It is hence easier to enter a tight stricture while the probe is in the electric circuit; but this is true only if the probe forms the negative pole. If, on the contrary, the probe is positive, it is grasped more firmly. The positive sponge should be applied to the side of the nose, and unpleasant electric shocks can be avoided by making the contact with the sponge gradual in order not to bring the current to its full strength instantly.

The electrolytic operation should be scarcely more painful than probing. The writer can speak very emphatically on the basis of his own experience of the value of electrolysis, although it does not seem to be as yet in general use. The treatment must be persisted in until the probe last used enters freely at the next sitting or until all complaints of watering have ceased. It must not be forgotten, however, that with a fully patent passage watering may still continue on account of abnormally free secretion of tears. The same diseases of the conjunctiva or of the nasal mucous membrane which led to the lachrymal obstruction may by themselves cause excessive flow of tears. No treatment can

[1] *Diseases of the Eye*, 1883.

[2] *Brit. Med. Journal*, Dec. 24, 1887.

give an absolute guarantee against relapse of lachrymal stricture if the original causes of it continue.[1]

Eversion of the Punctum is occasionally the cause of persistent epiphora. This can be cured by slitting the canaliculus so as to convert it into an open gutter facing inward.

Suppuration of the Tear-sac (Dacryo-cystitis).—This disease shows itself by the accumulation of pus in the tear-sac.

As the antero-lateral wall of the sac becomes dilated in the course of the disease, the sac when full forms a bulging prominence at the inferior internal angle of the orbit. This can be emptied by gentle pressure, either upward into the conjunctival sac or downward into the nose, according to which path offers the least resistance.

Dacryo-cystitis is often, but not invariably, accompanied by stricture, either at the junction of the sac and the canaliculi or toward the nasal end of the duct. The writer cannot share the current view that the stricture is the cause of the purulent inflammation, for the history of dacryo-cystitis is not ordinarily that of a previous stricture without suppuration.

On the other hand, cases of dacryo-cystitis without stricture are sometimes met with. The disease is an infection of the tear-sac by pus-micrococci. Where an origin can be traced the inflammation of the tear-sac seems to have followed some form of nasal disease, especially a suppurative rhinitis, or, less frequently, erysipelas of the face. Such causes, as well as the continuous suppuration of the sac, are sufficient to account for any coexisting obstruction of the passage. Even when the tear-duct is not narrowed the tenacious pus in the sac impairs its function of carrying off the tears.

Hence dacryo-cystitis causes necessarily the same symptoms as simple stricture—viz. overflow of tears whenever they are secreted, be this continuously or only on special irritation. Like simple stricture, dacryo-cystitis is apt to lead to chronic conjunctivitis and blepharitis. But besides this it is a continuous danger to the eye, for the infectious secretion containing virulent pus-micrococci may cause purulent infection of the cornea whenever the latter is accidentally wounded.

The essential principle in the treatment of purulent inflammation of the tear-sac is to give free exit to the pus. Hence the canaliculus should be freely divided, and the incision should extend into the sac. If the large probe encounters any further obstacle lower down, such stricture can also be cut with the blunt-pointed narrow knife pushed into the nasal duct. Subsequently the sac must be emptied of its purulent contents by pressure every few hours. In very young children the writer has sometimes seen dacryo-cystitis heal by system-

[1] The use of lead stylets left continuously in the duct has been generally discarded.

atic evacuation with the finger kept up for weeks without the use of the knife.

In adults this would not occur. If the passage does not retain its patency, large probes should be used periodically. In this case electricity may be used to the same advantage as in simple stricture. The cure can be hastened by means of injections through the lachrymal duct. In fact, some cases can only be cured by these means. We can make use of hollow probes into the conical end of which the tip of a rubber bulb-syringe fits. A blunt canula attached to a hypodermic (or Anel's) syringe will also answer, but is less convenient. Injection of merely sterile water is of service in washing out the pus. Of the various astringents in vogue, the writer has seen the best effects from solutions of nitrate of silver, 1 to 5 per cent. in strength. Great care must be taken that this fluid does not escape into the conjunctival sac. I have also seen decided advantage from the use of borated glycerin injections (1 part of boric acid in 4 of glycerin). As the result of such treatment the yellow pus changes speedily into transparent glairy mucus, diminishing likewise in quantity. It may take, however, a long time, even many months, before this stage changes to the normal condition. Sometimes the cause of the persistence will be found to be dead bone detected by the probe. Operations, however, for its removal cannot be recommended on account of the anatomy of the parts. In such cases I have found a beneficial effect by suspending iodoform in the borated glycerin. The treatment of dacryo-cystitis by medicated gelatin bougies or medicated catgut probes I have not found equal to injections.

Phlegmon of the Tear-sac.—Purulent inflammation of the tear-sac extends in some instances to the tissues outside of the sac. The skin between the lower lid and the bridge of the nose becomes reddened and infiltrated, and if not treated promptly the pus will find vent through a lachrymal fistula. At its beginning the disease may be mistaken for erysipelas, but the history of previous watering of the eyes will aid in making the diagnosis. The disease is usually painful, and the resulting fistula proves very obstinate. The treatment is the same as in simple dacryo-cystitis; but if on account of the swelling the sac cannot be entered by way of the canaliculus, it is preferable to incise the sac at the most bulging point, for the fistula resulting from the clean cut heals easier than the hole formed by burrowing pus. As soon as the swelling subsides the sac should be opened from above. As the pus begins to diminish the closure of the fistula can be favored by blowing iodoform into it and closing it with collodion. An old and neglected fistula may require destruction of its walls by means of nitrate of silver or the galvanic cautery.

If phlegmon of the tear-sac cannot be cured or relapses persistently,

the better plan is to obliterate the sac. It should be opened freely by an incision through the skin, curetted thoroughly, and then cauterized with nitric acid, or still better with a hot wire. We thereby remove the danger to the eye arising from a suppurating sac, while the resulting watering, although incurable, is generally only very slight.

DISEASES OF THE EYELIDS.

Diseases of the Skin of the Lids.

The skin of the lids is subject to the same forms of affections as the rest of the integument. As skin diseases in general are fully discussed in another part of this work, there is no object in a mere repetition.

It must be remembered, however, that cutaneous lesions of the lids are apt to be accompanied by greater swelling and œdema than in other parts of the body, on account of the redundancy and mobility of the skin and its loose attachment to the deeper parts. On account of the proximity of the eye, irritant applications must be used with greater caution than on other parts of the surface. Chrysarobin, for instance, cannot be applied to the lids without the risk of a severe inflammation of the conjunctiva or even of the deeper parts of the eye.

Insufficient Length of the Skin of the Eyelids has been described by Fuchs[1] as a not uncommon condition which may lead to morbid consequences. Where the skin is insufficient, so as to be drawn unduly tense on closing the lids, the person cannot close the eyes so as to bring the edges of the lids into actual contact without more than the ordinary unconscious effort. It is only by a conscious exertion that such an eye can shut completely. He is therefore apt to sleep with the eye partly open. While the cornea rolls upward during sleep a portion of the sclera remains exposed to the air in such patients, and this nocturnal irritation by drying of the sclera and the deposition of dust upon it is a source of blepharitis, chronic conjunctivitis, and over-secretion of tears. In any suspected instance the diagnosis can be made by ordering the patient to shut his eyes gently and without effort, in which case a few millimetres of sclera remain still uncovered. Fuchs has shown that the lids are insufficient for their function if the skin of the upper lid is not at least *one and a half times as long* as the distance from brow to lashes. The height of the lid is measured from the brow to the free margin while the eye is gently closed, and the repetition of this measurement on pulling the lashes downward and the eyebrow

[1] *Arch. f. Ophth.*, vol. xxxi., Part ii., p. 97.

upward with the fingers, so as to put the lid on the stretch, gives the length of skin.

The effects of the insufficiency can be combated by closing the eyes at night with a pad and bandage. The writer prefers a strip of gold-beater's skin adhesive plaster for this purpose.

Temporary closure of the lids by these means obviates the evil results, but serves also in restoring the proper function of the lids. Where the insufficiency is very excessive, the lid-aperture may be shortened by the operation of tarsorrhaphy.

Diseases of the Tarsus and the Edge of the Lids.

Blepharitis.—*Synonyms:* Blepharitis ciliaris, Blepharo-adenitis, Ophthalmia tarsi.

This disease is characterized by an inflammatory redness and more or less swelling of the free border of the lid. According to the localization of the inflammatory process we can recognize three different forms of inflammation of the edge of the lids—viz.:

I. Squamous Blepharitis.—In this form loose scales are found on the reddened edge of the lid, usually adhering to the cilia. Underneath the scales the skin is intact.

II. Ulcerative Blepharitis.—The ulcers, mostly superficial, involve the openings of the ciliary hair-follicles. They are commonly covered with firmly adhering crusts.

III. Interstitial Blepharitis, a condition of diffuse inflammation of the ciliary part of the tarsus without either ulceration or desquamation. This form may coexist with either of the other varieties of ciliary inflammation, and being more persistent it may continue after the superficial lesion has been cured.

While these forms represent really different processes and require different local treatment, we can consider them in common as far as their etiology and clinical history is concerned.

Inflammation of the edge of the lid is a very common disease. It does not begin often during infancy, but most frequently during childhood, especially toward puberty, and less commonly in advanced life. It may come on so gradually that its exact date cannot be stated, or it may begin more severely, generally in the course of an acute nasal catarrh or some infectious fever like measles. It has little tendency to heal spontaneously, evidently because certain conditions (to be detailed subsequently) which favor its occurrence are not apt to cease except under treatment. Some patients, however, lose their disease gradually after puberty.

Blepharitis may in some instances cause no annoyance whatsoever (except the trifling disfigurement), while in others it produces a feeling of heaviness and burning in the eyelids, or even distinct pain, aggra-

vated by exposure to wind or any use of the eyes. In extreme cases it may lead to inability to use the eyes for any length of time on account of fatigue, pain, or watering. Of course all gradations between these extremes may occur, from practical indifference to considerable sufferiug. Eyes with blepharitis are usually quite sensitive to slight irritations, such as smoke, dust, and wind. The disease in any of its forms causes falling out of the eyelashes. But this loss is not permanent unless the disease lasts indefinitely. The ulcerative form is more apt to lead to permanent loss of the cilia than the other varieties. A more serious danger is the liability to irregular shrinkage of the tarsus, especially as the result of long-standing interstitial blepharitis, resulting in turning in of the eyelashes or even of the entire edge of the lid, for this condition endangers the transparency and integrity of the cornea, besides keeping the eye in a state of continual irritation. Blepharitis is often accompanied by slight but persistent catarrhal conjunctivitis, probably the result of the same influences as the blepharitis itself. The squamous form of the disease can scarcely be called a danger to the eye. But in patients, especially children, suffering with the ulcerative form of blepharitis, ulcers and infiltration of the cornea are sufficiently common to justify the suspicion that the occurrence of corneal disease is favored by the inflammation of the lids. This view is confirmed by the favorable influence which treatment of the ulceration on the edge of the lid by nitrate of silver often exerts on the course of the corneal disease.

In considering the etiology of blepharitis we must take into account certain morbid conditions, one or more of which are found in nearly every instance of the disease. The result of treatment shows them to be the predisposing conditions which may lead to the inflammation of the border of the lid.

1. Blepharitis, especially the ulcerative and interstitial forms, often results from obstruction of the tear-passages. Since the irritation of the inflamed lid may cause by itself an augmented flow of tears, the mere watering of the sensitive eye is not sufficient evidence of lachrymal stricture. But when disease of the lachrymal passage can be shown to exist by the accumulation of pus in the sac or by the resistance met by the probe on sounding the duct, a cure of the blepharitis cannot be expected until the lachrymal anomaly is removed.

2. In certain instances nasal disease stands in a causative relation to blepharitis. This may take any form, hypertrophic, atrophic, or purulent rhinitis, or simply obstruction of the nasal passages. The frequent coincidence of blepharitis with nasal disease, with precedence of the latter, suggests their relationship. But the persistence of the nasal anomaly does not always prevent the cure of the blepharitis by local means. Yet cases are not rarely met with which prove refractory

to all treatment until the nasal passages are restored to their normal condition, while occasionally a blepharitis will disappear without applications to the lid during the course of successful nasal treatment.

3. A number of patients with blepharitis suffer from eye-strain due to hypermetropia or some form of astigmatism. That this strain is one of the conditions favoring the inflammation of the lids is shown by the greater readiness with which a previously obstinate blepharitis often disappears after the correction of the optic defect by suitable glasses.

4. In a limited number of instances of refractory blepharitis, generally the scaly form, the underlying fault is found to be a shortness of the skin of the lids, in consequence of which the patient cannot close his lids, so as to make their edges come in contact, without conscious exertion. No permanent cure can be obtained in such cases unless the lids are kept closed during sleep by a bandage or an adhesive strap.

I. Squamous blepharitis affects both eyes and both upper and lower lids uniformly in most instances. It is evidently a disease analogous to pityriasis or seborrhœa of the scalp. Its characteristic feature is epithelial desquamation extending into the glands. The redness of the border of the lid may be very slight. Whether it is directly due to infection is not known. But, as a rule, one of the previously mentioned predisposing conditions will be found present. Yet these are only influences which favor the occurrence of the disease, but cannot be called a direct cause of it, and, in spite of their persistence, most cases can be cured by local treatment. Mercurial preparations are most commonly used for this purpose. A salve consisting of white precipitate (ammonio-chloride) or the yellow oxide of mercury in 15 parts of vaselin may be rubbed into the roots of the cilia before retiring. If the mercuric oxide contains soluble impurities it will be found unpleasantly irritant. The writer has found Merck's yellow oxide unobjectionable in this respect. In using this or any other salve the scales should be removed before application. Where they are very adherent the writer has used to advantage a 10 per cent. solution of chloral in water for moistening the edge of the lid, with care not to get it on the conjunctiva. If at all successful, mercurial preparations will gradually improve the condition of the lids, so that a relative cure can be accomplished in three to four weeks; but it is always advisable to continue their use for weeks, or even months, in order to guard against a relapse. If no decided benefit is obtained inside of two weeks, this treatment will be found insufficient no matter how long continued. The writer has found a combination of precipitated sulphur and resorcin in the form of a vaseline or lanoline salve (2 to 3 per cent.) a much more reliable remedy. This sulphur ointment will generally restore a normal condition of the lids inside of three weeks,

though on account of the tendency to relapse it is best to continue its use a few times a week for perhaps another month. Yet, while more effective than a mercurial preparation, it cannot be depended upon to remove the disease in every instance. In a fair minority of patients all local treatment will either prove inert or incapable of preventing relapses, unless the influence which the previously detailed conditions exert upon the lids be removed. Suitable glasses to avoid eye-strain, treatment of nasal affections, restoration of the permeability of the lachrymal passages, or nocturnal bandaging of the gaping lids may be found indispensable in conjunction with local applications to the edge of the lids in order to effect a cure.

II. Ulcerative blepharitis may be one-sided or bilateral. It usually involves the upper lid more than the lower one. The ulceration is due to the invasion of the parts by the pus-micrococci, the presence of which has been proven. But this invasion seems to occur only when the predisposing influences repeatedly dwelt upon interfere with the nutrition of the lid, either by venous stasis or by irritation from overflowing tears. The ulcers can be cured in the speediest manner by the application of nitrate of silver, preferably in the form of a pointed stick (or a bead melted on a probe). Of course crusts must first be removed mechanically or by soaking. As the cleaning process as well as the cauterizing is painful, it is not superfluous to brush the edge of the lid with a strong cocaine solution. As long as the ulcers do not cicatrize the cauterizing should be repeated every second day. The healing progresses faster if a zinc salve is kept on the inflamed surface, preferably this formula:

Hydrarg. oxid. flav.,	gr. xv;
Zinc. oxid.,	ʒiss;
Vaselin.,	℥ss.—M.

Sig. To be used warm enough for easy application.

If no decided improvement results within one week it will be found necessary to remove the conditions which maintain the blepharitis. With the healing of the ulcers the cure is complete in uncomplicated cases.

III. Quite often, however, after the ulcers have healed the margin of the lid is still inflamed, on account of complication with *interstitial blepharitis*. This variety of blepharitis is of all forms the most difficult to remove. It is evidently an inflammation of the tarsus in the region of the Meibomian glands. The redness extends farther and the thickening is more marked in this form than in the other varieties of blepharitis, if not complicated with it. It is rarely possible to remove interstitial blepharitis without close attention to the prejudicial

influence or influences which maintain the disease. Sulphur ointment is of no benefit in this form, while the yellow-oxide salve is often curative. The writer has used to advantage vaseline or lanoline salves containing 15 per cent. of pyrogallic acid or ichthyol where mercurial preparations proved insufficient. In some instances the starting-point of the disease seems to be in the hair-follicles, and epilation of all the lashes that yield easily to the pull of the forceps proves an effectual aid. As a rule, interstitial blepharitis will be found an obstinate ailment of uncertain duration, and, unless all influences favoring the disease are corrected, relapses are very apt to occur after an apparent cure.

Chronic Tarsitis is a very rare affection, characterized by dusky redness and considerable swelling of the lid. The seat of the inflammation is the plate of connective tissue known as the tarsal cartilage. It sometimes leads to the formation of small abscesses. In some of the instances it seems to have been a late manifestation of syphilis, and yielded to specific treatment. The abscesses should be treated surgically.

Hordeolum, or **Stye**, is a minute abscess at the cutaneous side of the margin of the lids. Its centre is a hair-follicle or a gland: within two or three days after the escape of the pus the lid will be normal. Hence it is best to prick it as soon as the site of the pus can be determined. Sometimes several styes occur together, in which case the lid may present a furuncular appearance. In this condition the free use of a (very sharp) knife and perhaps the gentle application of a small curette constitute the quickest treatment. Styes are apt to recur, but this recurrence can be checked by the continuous use of an ointment containing yellow oxide of mercury. (See Treatment of Blepharitis.)

Chalazion is a tumor of the tarsus in the region of the Meibomian glands. It begins usually insidiously, sometimes with slight inflammatory symptoms, and rarely exceeds a large pea in size. Often the tumors are multiple. It may bulge either on the cutaneous side of the lid, with slight reddening of the skin, or may proceed toward the conjunctival surface and ultimately perforate there. The typical chalazion consists of granulation tissue, with giant cells inside of an apparent but not real capsule formed by condensation of the surrounding tissue. It starts from a Meibomian gland. The contents become soft or even fluid in many cases by a mucoid (or caseous?) degeneration. Tangl[1] has claimed a tubercular nature of the chalazion by demonstrating the presence of tubercle bacilli. While this view agrees with the histology of the tumors, it must be stated that clinically a chalazion is neither locally malignant nor infectious to the system. In fact, it need not be removed except for the local annoyance which it causes.

[1] *Centralblatt. f. prakt. Angenheilkunde*, Jan. and Feb., 1891.

Chalazion can only be cured surgically. The incision is made transversely through the skin if the tumor projects outwardly, or vertically through the conjunctiva if it points inward. If the contents do not escape on pressure a small curette must be used. It is only in those instances where the curette cannot scoop out the contents that the extirpation of the tumor with a piece of the conjunctiva and of the tarsus is necessary. The recurrence of chalazion seems to be controllable by the use of yellow-oxide-of-mercury salve.

Retention Cysts of the Meibomian Glands, which cannot be distinguished from a true chalazion in the intact lid, require only an incision for the escape of their purulent contents.

Diseases of the Muscles of the Lids

Blepharospasm (Spasm of the Orbicularis Muscle).—Blepharospasm occurs either as (1) clonic or (2) tonic contraction of the lids.

The clonic spasm may (*a*) be limited to simple twitching of the eyelids, (*b*) amount to twitching of the lids associated with jerking of other facial muscles (tic spasmodique), or (*c*) appear as part of chorea of the face.

(*a*) Frequent twitching or closure of the eyelids, uniform in both eyes, is a common affection, especially in children. It is due to the exaggeration of the normal reflex movement of the lids, and the cause of the reflex can usually be found and removed. Perhaps most frequently I have found it to be a slight conjunctivitis, especially of the follicular type. In such cases nitrate of silver (1 or 2 per cent. solution) brushed on the conjunctiva, or a collyrium of $\frac{1}{2}$ per cent. sulphate of zinc (more active if $\frac{1}{2}$ per cent. cocaine be added), will speedily stop the annoyance. Rarely a foreign body under the lids is the cause. In other instances the removal of eye-strain by correcting a faulty optic condition with glasses will stop the blepharospasm. If not in the eye, the cause may be found in the nose, which should always be examined. Quite often I have removed slight subacute nasal catarrh by insufflation of nitrate-of-silver powder (1 part in 6 of talc) or by the frequent use of menthol spray (1 in 6 of albolene), and this ended the twitching of the lids. In other instances excessive cavernous tissue or ridges on the septum may require operative interference. Sometimes it has seemed as if the spasm were the result of the joint influence of eye and nose irritation, and it did not cease until both anomalies were corrected. Even if the cause is not plain, the chronic blepharospasm will often cease after a variable time, especially if the eyes be rested and the health be invigorated by an out-door life.

(*b*) Clonic Blepharospasm, associated with twitching of the other muscles innervated by the facial nerve, is sometimes but the extension of the reflex as described under (*a*).

Another possible source of the reflex that must not be overlooked in these cases are the teeth. Most serious, however, are those instances in which no local origin can be found, especially if only the facial nerve of one side be involved. They come practically under the head of *tic spasmodique* (consult Diseases of Nerves) and are often incurable.

(*c*) Blepharospasm sometimes appears not as twitching, but in the form of irregular *slow* movements involving other facial or perhaps the external ocular muscles as well as the orbicularis.

This condition must be regarded as a localized chorea.

Occasionally it can also be shown to be a reflex due to similar causes as the previously described form of blepharospasm. When no such origin can be traced the prognosis and treatment are the same as in other forms of chorea.

Tonic Blepharospasm consists in a steady spasmodic closure of the lids, often accompanied also by spasm of the adjoining muscles of the face and forehead. It is the result of some disease of the anterior part of the eyeball causing sensitiveness to light, most frequently perhaps phlyctenular keratitis. The spasm, however, may persist after the disease causing it has disappeared, and may then prove very obstinate to treatment.

The first step must necessarily be to hasten as much as possible the cure of the conjunctival or corneal disease. If a corneal ulcer has left a scar, which shows by continued ciliary injection of the eyeball that it is still the seat of an irritant process, it may be best to destroy it by the galvanic cautery. If no actual disease remains, the periodic benumbing of the conjunctiva by a 2 per cent. solution of cocaine may lead to gradual relaxation of the spasm.

Dipping the face into cold water has also proven of service. In cases rebellious to all other treatment Von Graefe has frequently cut the supraorbital nerve subcutaneously with perfect success. Application of tincture of iodine over the area supplied by this nerve has also been found useful. The properties of antipyrine make it seem probable that large doses might check such obstinate blepharospasm, but as far as I know it has not yet been tried.

There are on record a limited number of cases in which tonic blepharospasm of many weeks' duration was followed by amaurosis. But this blindness, apparently of cerebral origin, was only transient, and the recovery complete after a few days or weeks.

Paralysis of the Orbicularis Muscle.—The partial or complete inability to close the lids, known as *lagophthalmus,* is a symptom of paralysis of the facial nerve. This condition is apt to lead to watering of the eye, blepharitis, and chronic conjunctivitis.

The cornea may also suffer, although this structure is protected by

the upward rolling of the eyeball during sleep. To guard against these complications the lids should be closed at night by a bandage or a strip of thin adhesive plaster. If this does not suffice and the paralysis be incurable, the size of the lid aperture can be diminished by the operation of tarsorrhaphy. The inner edges of the upper and lower lid are denuded for a distance of 5 to 10 millimetres at the external canthus, and caused to unite by a couple of sutures.

The prognosis and treatment of the paralysis depend, of course, on the causes and pathology of the lesion of the facial nerve.

Paralysis of the Levator Palpebræ Muscles.—*Ptosis*, the partial or complete inability to open the eye on account of relaxation of the levator muscle, is the result of paralysis of the corresponding branch of the third nerve. It is generally associated with paralysis of the ocular muscles innervated by the motor-oculi nerve. The causes of such paralysis may be syphilis (gummatous meningitis), tabes, disseminated sclerosis, polyo-encephalitis media, tumors in the skull or orbit, or an idiopathic neuritis (rheumatic?) of the motor oculi.

The prognosis and treatment depend, of course, upon the cause. In incurable cases the power of opening the lid may be partly restored by an operation. The various operative measures devised amount practically to an advancement of the tendon of the levator muscles, so as to increase its power of raising the tarsus.

Ptosis may be of other than paralytic origin. Congenital inability to open the lids to the normal extent is not uncommon. Sometimes this results from insufficient development of the levator muscle; in other instances it is evidently due to a prenatal paralysis.

In consequence of old granulations or other conjunctival disease of hypertrophic character or repeated inflammatory swellings of the skin of the lids, ptosis may also occur on account of a weight of the lid too great for the strength of the muscle.

In all these instances operative treatment is not so reliable that it can be recommended for any but the higher degrees of ptosis.

Mere excision of an elliptic fold of skin from the upper lid is of permanent use only when the ptosis is clearly due to a redundancy of skin, which is not usually the case. An attempt may be made to transfer the power of elevating the lid to the frontal muscle by forming cicatricial bands from the tarsus to the muscle above the eyebrows by means of buried sutures. But this is not always successful. Electricity in the form of the induced current is sometimes of service in strengthening the levator muscle.

Deformities of the Eyelids.

Ankyloblepharon is a condition in which the lid is partly or completely adherent to the eyeball on account of a cicatrix from former

burns or more rarely from ulceration of the conjunctiva. This state can be corrected only by surgical means. The more extensive the adhesion, the less success can be expected of any operation. After the united surfaces have been dissected apart they will inevitably reunite, unless one, or still better both, of them be covered by mucous membrane, obtained either by sliding or by transplantation from the mouth or an animal's conjunctiva.

Symblepharon is the union of the edges of the upper and lower lid, the result of cicatricial contraction after some injury. Very often it is complicated with attachment of the lids to the eyeball, which makes the prognosis of an operation more doubtful.

In the uncomplicated cases the lids are separated by an incision with care not to wound the eyeball, and the skin and mucous membrane are stitched together at the corners so as to avoid reunion of the raw surfaces.

Blepharophimosis is a narrowing of the lid-aperture due to rigidity of the skin. It occurs in the course of diseases of the conjunctiva and cornea attended with sensitiveness to light, watering, and blepharospasm. It can be relieved by the operation of canthoplasty—*i. e.* extending the lid-aperture at the external canthus.

Distichiasis and **Trichiasis** are the terms applied to inversion of the eyelashes, the former in the case of the inversion of one distinct row of hairs, the latter when some or all of the hairs are turned in irregularly. The rubbing of the inverted lashes against the eyeball is a source of great discomfort, and causes sooner or later surface opacity of the cornea, usually vascular. The corneal transparency can only be restored by removing the lashes in comparatively recent cases. The inversion of the lashes is easily recognized if many are turned. But if only a few are involved they may easily be overlooked, since inverted lashes become very pale and delicate. The surest way to find them is to look for the minute accumulation of fluid which gathers around each lash by capillary attraction, especially noticeable when the cornea is in contact with the edge of the lid. Trichiasis is the result of tarsal shrinkage either after old granulations or persistent blepharitis. The inverted lashes should be pulled out with broad tweezers without teeth, but firm bite, as soon as the patient feels their presence. If only a few hairs are turned the bulbs may be destroyed by electrolysis. A fine cambric needle connected with the negative pole of four to six cells is thrust into each hair-follicle, and the current is made gradually and kept about one minute. On account of the delicacy of the hairs the manipulation is difficult and may have to be repeated. The faulty direction of the hair-follicle may be corrected by a suture put through it and tied firmly over the free edge of the lid and left until it cuts through. Besides being disagreeable

this operation is not always successful. For any extensive inversion of the lashes an entropion operation should be performed.

Entropion.—In consequence of shrinkage of the tarsus after trachoma or any deep conjunctival ulceration the free margin of the lid becomes turned inward, sometimes with incurvation of the tarsal plate (in the vertical direction). The consequences are those of inverted lashes—viz. irritation of the eyeball and opacity of the cornea. The only remedy is an operation. This may be based on one of two principles: 1. The edge of the lid may be kept in its normal position by cutaneous traction. For this purpose the skin is made to adhere firmly (by means of sutures) to the denuded upper border of the tarsus in the case of the upper lid, the lower border in the case of the lower lid. If the shrunken tarsus is distinctly convex, its shape may be corrected at the same time by exsection of a wedge-shaped piece.

2. The other principle on which various modifications of entropion operations are based is to split the free edge of the tarsus into an anterior and a posterior plate by means of an incision parallel to the plane of the tarsus. The outer tarsal lamella is to contain all the hair-follicles. This external portion is then drawn away from the edge of the lid by removing an elliptic piece of skin parallel to the border of the lid and at a distance of about five to ten millimetres from it. By suturing the skin over this gap the tarsal lamella containing the hair-bulbs is drawn away from the conjunctival part of the tarsus, and the lashes are thus brought into their proper position. The gap between the two tarsal segments is either allowed to close by granulation or is covered with transplanted skin (the exsected piece of the lid) or transported mucous membrane. Successful entropion operations require considerable nicety, especially if we wish to avoid subsequent relapses.

A transient form of entropion of the lower lid is apt to occur in elderly people with relaxed skin whenever any irritation keeps up prolonged watering of the eyes. The protection of the skin by zinc ointment or collodion is usually sufficient for relief after the watering has ceased.

Ectropion is the eversion of the margin of the lid whereby the conjunctiva is partially separated from the globe.

The exposure of the conjunctiva to the air keeps up an irritation of the eye, and conjunctivitis and blepharitis are apt to result. Its usual cause is the traction of cutaneous cicatrices. In order to relieve this condition the deep attachment of the scar must be loosened with the knife (or, if necessary, the entire scar can be extirpated), and the deficiency of skin is to be supplied by sliding a flap from the adjoining skin or by the transportation of detached pieces of epidermis from other parts. Considerable allowance must be made for subsequent shrinkage.

Occasionally, entropion is not due to traction from without, but to a hypertrophic condition of the conjunctiva, perhaps the result of lachrymal stricture. In this case no operation is required on the skin. The restoration of the thickened conjunctiva to its normal condition can be aided by temporarily closing the lids by a bandage.

Tumors of the Lids.

The eyelid is a comparatively frequent seat of tumors. Cysts and fatty growths are the most harmless of the tumors, and need removal only on account of their size or the disfigurement which they cause. Warts are not rare. In advanced life warts should not be allowed to remain, on account of a possible transformation into epithelial growths. They may be snipped off and their base cauterized with glacial acetic acid. Nævi are also very common. They can be obliterated with the least disfigurement by electrolysis. Needles are inserted at different places and a current of four to six cells is sent through them. If extensive, they may require rather numerous sittings.

The most serious neoplasms of the lids are lupus and epithelial cancer. Both occur more frequently on the lower than on the upper lid. The two diseases are not easily distinguished in their incipiency. (Compare Diseases of the Skin.)

They both consist at first of small hard elevations, which after a while tend to ulcerate, but do not either grow or break down rapidly. Later on the character of the cancer as an encroaching tumor becomes more apparent when compared with the moderate infiltration of lupus.

The diagnosis between the two, if impossible by mere appearances at an early period, may be decided by means of the local reaction produced by tuberculin injections in lupus. We can either watch for the inflammation of the lupus patch resulting from a single large diagnostic dose (1 increased, if necessary, to 3 or 5 milligrammes) or we can wait for the gradual curative influence of minute increasing quantities ($\frac{1}{10}$ milligramme upward).

While the experience with tuberculin has shown that lupus can generally be cured by its cautious and persistent use, we do not know yet whether all relapses can be prevented or cured ultimately. If this agent should fail, the curette and the localized galvano-cautery have to be depended upon.

In epithelioma of the lid the prognosis is quite favorable as long as no lymph-glands (especially the pre-auricular gland in front of the tragus) have become involved, and the cancer has not encroached toward the orbital cavity so as to render its complete removal doubtful. Excepting operation no treatment deserves confidence. Caustics can only act if they destroy as much tissue as the knife would remove, and in doing so they leave a much more disagreeable wound.

The application of chlorate of potassium in the form of powder has resulted in an occasional cure in alleged cancer. In view of the slow growth of the epithelial tumor it may be tried. But if no unmistakable influence is shown within one or two weeks, no further time should be wasted. If the tumor can be thoroughly extirpated without removing more than six millimetres of the lower lid in the vertical direction (no matter what width), the resulting defect will not interfere with the function of the lid, and even the cosmetic effect will correct itself ultimately through the influence of the orbicularis muscle. But if more tissue has to be sacrificed in order to eradicate the cancer, the lid must be restored by some form of plastic operation.

In conformity with the general plan of this treatise the writer has not entered into surgical details, but has sketched only the salient diagnostic points and the principles underlying the treatment of the purely surgical affections. Further details can be found in any treatise on diseases of the eye.

DISEASES OF THE OCULAR MUSCLES, PARALYTIC AND CONCOMITANT SQUINT, ASTHENOPIA, SPASMS OF THE OCULAR MUSCLES, AND NYSTAGMUS.

By LUCIEN HOWE, M. D., F. R. C. S., England.

The Editor of this work asked me to contribute the chapter on "Diseases of the Ocular Muscles, Paralytic and Concomitant Squint, Asthenopia, Spasms of the Ocular Muscles, and Nystagmus," but in considering the practicability of condensing the contents of volumes of ophthalmological literature into about thirty pages it seemed necessary to divide the whole subject into two main portions—chiefly, asthenopia on the one hand, and strabismus in its varied forms on the other—adding then what little might be required regarding the therapeutics of the more rare forms of diseases of the muscles of the eye.

In such an article, designed for general practitioners, evidently any attempt at originality must be disclaimed, and the discussion of mooted points also omitted, however tempting they may be to the specialist. Even technical terms must be avoided when possible; in fact, everything must be sacrificed to clearness. With this end in view, it seems preferable to err in the direction of giving too many elementary details rather than cause the least confusion by condensed technical statement. For the sake of a proper understanding of terms it will be advisable to describe briefly the various diseases considered, and in doing so occasional reference must be made to anatomy and physiology. Moreover, as the first step toward a rational treatment is the removal of the causes producing a disease, so should these also be clearly given. With such limitations, however, the subjects treated in this article will be regarded from the therapeutic point of view, and as nearly as possible from that alone. Without further preface, therefore, let us proceed at once to the study of—

Asthenopia.

This term is employed to describe that group of symptoms which older writers were accustomed to class together and call "weak sight." The one prominent and all-important feature of this disease is pain.

Usually it only accompanies effort at near work, but occasionally it is constant. The degree of the pain varies greatly, sometimes being only sufficient to attract the attention of the patient to what he calls a "straining" of the eyes; in other cases so severe as to be almost unbearable. Nor is this pain always confined to the eye alone; frequently it is quite as severe over the brow, and is either recognized as an "ocular headache" or called simply "headache." Sometimes it is felt in the top of the head, occasionally in the back of the neck, or in rare instances in the shoulder or arms. This pain is often erroneously supposed to be dependent upon changes of the interior of the eye. Almost every oculist has patients referred to him who come with the darkest forebodings of impending blindness because the cause of the difficulty is not apparent externally. They have been told that they were suffering from amblyopia or amaurosis or some other dreaded disease, which in an indefinite way is supposed to be characterized by such symptoms. I may say, by way of parenthesis, I concur with Carter, that when the patient complains of pain under such circumstances it is entirely safe to conclude that there is no disease of the retina or optic nerve.

The chief symptom of asthenopia, then, is pain. In addition, the patient usually complains of "blurring" of the vision, smarting of the eyes, slight increase of the secretion of tears on attempting to read, and in general those symptoms which accompany any conjunctival irritation. This is the type of the disease.

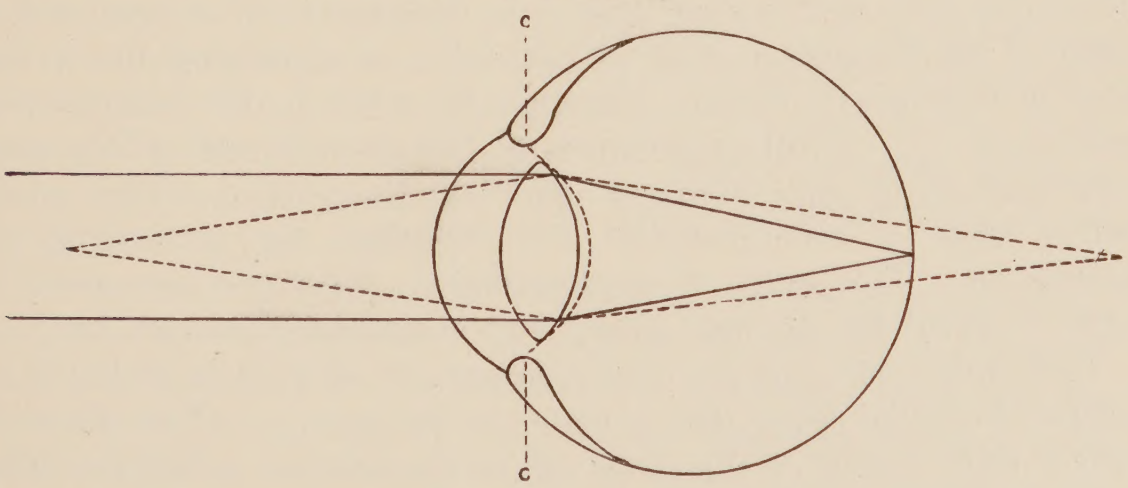
Asthenopia has ordinarily been divided into different forms depending upon the causes which produce the symptoms. One, called accommodative asthenopia, as the name indicates, is due to some imperfect action of the muscle employed in the act of focusing the eye for different distances; the second, called muscular asthenopia, being dependent upon some of the recti muscles. Of these two, it is evident that the first relates to the muscle on the inside of the eye, and the second to the muscles on the outside. A third class includes those cases in which the symptoms are dependent upon an abnormal condition of the brain-centres, and has therefore been called central asthenopia. A fourth variety may be added to this list—namely, a form of asthenopia due to the irritation of the lining membrane of the lids, conjunctival asthenopia, as it might be termed. It is evident from this classification that the subject is not a simple one. The very multiplication of varieties indicates what attempts have been made to arrange in order these cases so numerous and at the same time so very important from a clinical aspect.

I. The asthenopia which accompanies conjunctivitis, although the last form mentioned, is the first to which I would direct attention, as it is the most superficial and most readily understood. As a slight con-

junctivitis is one of the accompaniments or results of other forms of asthenopia, so does this disease itself cause almost typical asthenopic pain of slight degree, noticeable when reading, and especially when the eyes are used in the evening. It is not an easy thing always to say in a given case whether this conjunctivitis is the cause of the pain, or whether that and the conjunctivitis together are due to some exertion of the muscular apparatus of the eye. I know that it is unusual to consider asthenopic pain as a result of conjunctivitis, but clinical experience surely justifies it, and for the sake of clearness in a condensed statement like this it is desirable to separate that class of cases distinctly from those of accommodative, of muscular, or of central origin. The treatment of this form of asthenopia is of course nothing more than the treatment of a simple conjunctivitis. A solution of sulphate of zinc, in the strength of about 1 grain to the ounce of water, is the form usually employed. Instead of this solution we may, of course, use solutions of acetate of lead, 1 or 2 grains to the ounce, or camphor-water, or some other astringent in about the same proportion; the simpler and the less irritating the better.

II. The second form of asthenopia, and by far the most common, is that which depends upon the act of accommodation. It is therefore called accommodative asthenopia. The ciliary muscle always acts together with the recti muscles, which turn the eyes in or outward in such a manner that it is impossible to say at once that accommodative asthenopia is entirely independent of muscular asthenopia in any given instance. Still, with the large majority of cases the clinical features are so directly dependent upon an effort at accommodation that the

FIG. 131.



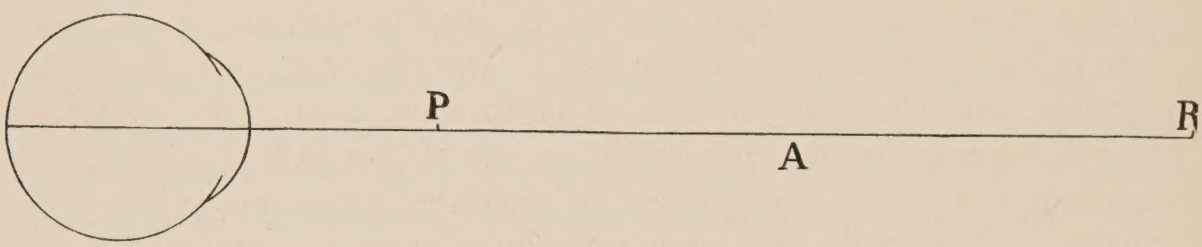
student soon recognizes in accommodative asthenopia the most usual and most important form of the disease. The symptoms do not differ materially from those of any other kind of asthenopia. Pain is ordinarily noticeable, and especially the blurring on attempting to read or sew or to accomplish any work which requires use of the eyes at a

near point, while, on the other hand, the smarting of the lids and the secondary symptoms are apparently slight.

It is not out of place, for the better understanding of the treatment, to refer here briefly to some elementary facts of anatomy and physiology. When the normal eye is at rest—that is, looking at a distant object twenty feet or farther—the rays which fall upon it then, being parallel, come to a focus exactly upon the retina. (See Fig. 131.) When the object is approached, however, the nearer it comes to the eye the more do the rays from it diverge, and the greater is their tendency to come to a focus behind the retina, and consequently make the image imperfect (Fig. 131, broken line). In order to compensate for this some action on the part of the eye is necessary. This is accomplished by contracting the ciliary muscle (Fig. 131, *c*); and that act is called "accommodation."

To make this clearer it is necessary to consider it a little more in detail here. Let us take first the simple act of accommodation with one eye. If we indicate the distance from the eye to the farthest point of dis-

FIG. 132.



tinct vision by R (see Fig. 132), and again the distance from the eye to the nearest point at which an object can be distinctly seen by P, then evidently the difference between these two distances (R–P) is equal to the range of accommodation which we can call A, or, expressing this in the form of a reciprocal fraction, changing the terms in the equation, we have $\frac{1}{A} = \frac{1}{P} - \frac{1}{R}$. A full explanation of this formula, and of the very wide field of its applicability, is found in the portion of this work which treats of accommodation and refraction, the prescribing of glasses, etc. This range of accommodation, where one eye alone is used, is called the absolute range, and is designated simply by $\frac{1}{A}$.

But when both eyes are used together, or when it is desirable to express binocular range, this is done by the term $\frac{1}{A^1}$. Now, there is still a third variety of the range of accommodation called the relative range, which it is frequently desirable to express. This is done by the fraction $\frac{1}{A_2}$. By that term we understand the range of accommodation which is possible while the convergence of the visual lines remains unaltered. For example, if a person directs the eyes to a certain letter of a book held about thirty centimetres (twelve inches) distant, and looks at that with both eyes, his accommodation then is

expressed by the fraction $\frac{1}{A}$. If now, with the same degree of convergence—that is, with both eyes still fixed upon the letter at the same distance—he places before his eyes a pair of convex glasses of plus two dioptrie (plus 20 inch), then, naturally, with this same convergence, in order to see the letter distinctly it will be necessary for him to relax his accommodation to an amount which is equal to two dioptrie—in other words, to focus the eyes for a point twenty centimetres farther off, although in reality they are converged for the same point only thirty centimetres distant. This convex glass, therefore, would measure such a portion of the relative range of accommodation, and, as it lies *beyond* the point of convergence, for convenience it is called the *negative* part of the relative range. If, on the other hand, he were to place before each eye a glass of minus one, then, naturally, with this same convergence (for thirty centimetres) it would be necessary for him to exercise a correspondingly greater degree of accommodation in order to see the letter distinctly; and this portion of the relative accommodation lying within the point, between that and the individual, is called the *positive* part of the relative range. Therefore the fraction $\frac{1}{A_2}$ would express the negative part of this range, together with the positive part, and the sum of these in the case supposed amounts to three dioptries. Now, this apparent digression is made principally for the sake of stating clearly a very important law based on a large number of observations; which is, that in order to do any near work with comfort *the positive part of the accommodation should be to the negative part about as three to two.* This is a rule upon which too much stress cannot be laid in the prescribing of glasses in almost all cases of asthenopia.

Now, in any case whenever an attempt to make the crystalline lens convex is painful—that is, when there is accommodative asthenopia—the thing to do is to place a corresponding convex glass in front of the eye, and thus save the ciliary muscle that amount of effort. This is the principle of the treatment. The details vary according to the special cause in that variety.

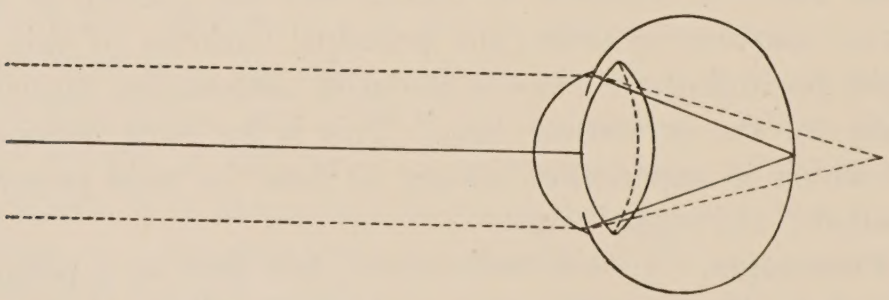
For the sake of clearness in considering this portion of the treatment let us consider, in order, the principal varieties of this form of asthenopia, beginning with accommodative asthenopia, caused by loss of elasticity of the crystalline lens. This is the most common form, and that which is experienced sooner or later by most persons, being the so-called "old sight," or—

(A) Presbyopia. It is a well-known fact that as a person grows older the crystalline lens become gradually harder and less flexible. Ordinarily, these changes pass unnoticed until the individual arrives at the age of forty-five or fifty, but by that time the lens has become so hard that the ciliary muscle can no longer render it sufficiently

convex to bring to a focus rays which issue from a point twenty-five to thirty centimetres (ten to twelve inches) in front of the eye; consequently convex spectacles become necessary for reading or other fine work, and, if the glasses selected are of proper strength, complete relief is afforded. Very many persons go to an optician of their own accord and obtain glasses for old sight, the selection proving in every way satisfactory, for with these individuals the glasses enabling them to see most distinctly are also those best adapted to their case. The greater number who fail in finding satisfaction do so because they have an unwarranted fear of what is ordinarily called "too strong a glass." The pain of asthenopia is the cry of the eye for greater assistance, consequently it will continue as long as any such demand exists. The best way is to choose a glass with which good print can be seen with distinctness at a distance of twenty-five to thirty centimetres, and then no frequent change is necessary. Persons often ask if exactness is essential in obtaining glasses merely for old sight, the very question evincing how little the importance of the apparently simple decision is appreciated. It is not only the choice of glasses which is to be determined, but sometimes whether the symptoms which suggest glasses do not point to one of those insidious diseases of the eye which appear as middle life is reached. For example, one of the morbid changes most threatening to vision is glaucoma; yet this is often manifested to the patient for a considerable time solely by the increase of what he considers "old sight."

(B) The next most frequent variety of accommodative asthenopia is that which is due to excessive demands upon the ciliary muscles in hypermetropia or far-sightedness. In order to gain a clear idea as to the manner in which this produces painful vision let us recall for a moment the form of the far-sighted eye. It is a well-known fact that this is an eye which is shortened from before backward, but in which the crystalline lens is of the same size and form as in any other eye. Fig. 133 shows this. The lens being of ordinary thickness, when

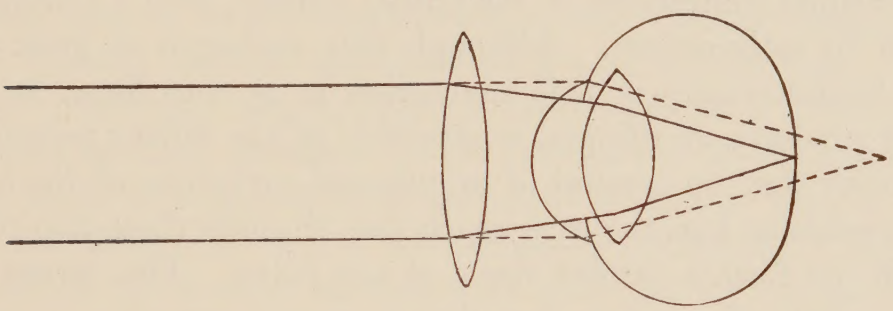
FIG. 133.



the eye is in a state of rest the only rays of light which could come to a focus upon the retina are those which approach in a convergent direction. Unfortunately, however, for the person possessing such

eyes, there are no such convergent rays in nature. The rays of light come practically parallel when the object is situated at a distance of about six metres (twenty feet) or more, or if it be situated within that distance the rays of light from it diverge. In other words, when the eye of the far-sighted person is in a state of complete rest, there is nothing which can be seen distinctly. When parallel rays strike the far-sighted eye they tend to come to a focus behind the retina. As a person having such an eye does not naturally see distinctly, it is necessary for him to exert a certain amount of effort even for distant vision. But if the object is situated near by—if the rays come, for example, from the page of a book at a distance of only thirty or forty centimetres (twelve or fourteen inches)—they approach the eye in a divergent direction. It is evident the lens must be made still more convex in order to obtain clear vision—that is, to bring rays to a focus on the

FIG. 134.



retina. Theoretically, then, every one who is in the least far-sighted would be benefited by wearing convex glasses; and practically these are often found essential to correct this second form of asthenopia. The strength of the glass is of course to be in proportion to the degree of the far-sightedness, and usually the strongest that can be borne is the best.

To a far-sighted person who has for a number of years suffered from pain in the eyes or headache on attempting to read the use of a simple convex glass gives great relief. Indeed, it is not infrequent to find that such a one has already resorted to this means of assistance without consulting an oculist. Many a child, studying in the evening when the light is poor and the print small, begins to complain of pain in the eyes, and, jestingly borrowing spectacles from some one, perhaps even an aged person, just for trial, to the surprise of the little student, and sometimes to the annoyance of the parents, finds these spectacles of evident service. The pain ceases, the print is clear, and lessons previously difficult are learned with considerable ease. The relief continues with the use of the glasses, or ceases if the parents forbid any such experiments, and the child is again subjected to the inconvenience of his far-sightedness. It can be laid down as a maxim in which all authorities concur that the sooner such glasses are

used the better; and also that the glass should be as strong as can be worn with any degree of comfort, though the popular opinion to the contrary is not an easy thing to overcome. The patient first inquires, "If I use these now, will it not become necessary to continue wearing them more constantly in the future?" Yes, undoubtedly that is true, but to compensate for this inconvenience relief is obtained, and the eye, besides, remains a useful, healthy organ a much longer time than it probably would otherwise. Again, the patient inquires, "Will I not require stronger and stronger glasses until a point arrives where none sufficiently strong can be obtained?" No, that is not the case. Although it is often necessary to increase the strength of the glass up to a certain time in life, beyond that no further change is necessary: the popular idea, therefore, apparently reasonable, has no basis in fact.

(C) The third variety of accommodative asthenopia is that caused by the unequal contraction of the ciliary muscle, such a condition as is produced by astigmatism. Although this variety is of great importance, it is unnecessary in this connection to go into detail to explain how that produces an unequal contraction of the ciliary muscle. Suffice it to say that on account of an unequal curvature of the cornea or of the crystalline lens the rays which pass through these two refracting media do not form a perfect focus at any point. The cornea, instead of being a part of a sphere, has then a greater curvature in one direction than in another. To use a rough illustration, it is shaped somewhat like the outer surface of a spoon. In order to overcome this unequal curvature it is necessary that the ciliary muscle contract irregularly, and this effect very often produces a typical, most annoying, and obstinate asthenopia. As astigmatism may be both of the far-sighted and the near-sighted variety—namely, one curvature of the cornea being less or greater than the normal—or may be a mixture of these forms, so this irregular curvature is corrected by glasses ground as cylinders, or by a combination of a cylindrical with a spherical lens, or of two cylinders. From what has been said it is evident that corrective glasses constitute the first step in the rational treatment of accommodative asthenopia due to astigmatism. To go into any further detail or to refer at length to the modifications of the glasses which can be used to advantage in this condition belongs properly to the section of this work which relates to accommodation and refraction.

There may be some irregular curvative in the cornea masked by the compensating action of the ciliary muscle in the lens; in other words, although subjective examination with the cylindrical glass may show but a small amount of astigmatism, there may be a considerable degree in the cornea, and a correspondingly great amount of effort

made by the lens to correct it. This is not a matter of theory, but is easily proven when atropine is used, perhaps for several days or more, or when the curvature of the cornea is measured, as can be done with ease by means of the Javal-Schiotz instrument.

(D.) Accommodative asthenopia may also be due, finally, to an inherent weakness in the ciliary muscle, such a condition as is found after exhausting disease, especially after diphtheria in children. But this is a variety which needs only to be mentioned for the sake of completeness, as the treatment evidently depends upon the therapeutics of the special disease producing the weakness, upon tonics and the building up of the general system.

It should be mentioned in this connection that a certain amount of asthenopia can also exist with myopia. This is not to be accounted for on the principle of any excessive action of the ciliary muscle itself, as in the case of far-sightedness, but rather to the weakness of that muscle in some cases or to the disturbance of the relation which we shall see later existing between accommodation and convergence.

When considering accommodative asthenopia as a whole, we find the majority of these patients simply far-sighted or old-sighted, and these can easily be disposed of, as ordinarily a suitable pair of convex glasses is sufficient to relieve the annoying symptoms. Again, for those in whom the amount of ametropia is slight, for myopes of very low degree, hypermetropes also of low degree, and especially in cases where the astigmatism does not exceed one dioptrie,—a pair of suitable glasses, although exceedingly weak, is sufficient to relieve the patients of a very troublesome asthenopia. Theoretically, this cannot be explained, as we know perfectly well that the existence of one or even two dioptries, or occasionally a much higher degree of astigmatism, passes without recognition in certain individuals. Still, the fact remains that a small amount of ametropia, especially of astigmatism, may be the cause of much pain, discomfort, and headache; all of which symptoms vanish when a correcting glass is given. Several of our American writers have laid stress on this point, and it is one the importance of which cannot be over-estimated.

Before leaving this subject of accommodative asthenopia its importance should be specially stated. As Roosa and others have shown us that in an absolutely normal eye emmetropia is rarely met with, and as all concur that a variation from that type is the most fruitful source of asthenopia, so, practically, in every case do we find that the adjustment of suitable lenses at the very outset either gives relief to the patient or by eliminating one important factor at least prepares the way for a clearer view of the problem presented.

III. The third form of asthenopia to which our attention is to be directed, muscular asthenopia, has for a long time been one of the great

stumbling-blocks in ophthalmic practice, and it will therefore be my endeavor to summarize such facts as are necessary to an understanding of the rational treatment, omitting theoretical considerations as completely as possible. It will be remembered that the globe of the eye is suspended in the socket by means of the four recti and the two oblique muscles. Of these there are two which particularly claim our attention, not only in this connection, but as of special importance later, when Strabismus is studied. These are the external and the internal recti. Arising from the apex of the orbit near the optic nerve, they pass forward to the sclerotic near the margin of the cornea. The internal rectus is inserted about four or five millimetres (two and a half lines) from the inner margin of the cornea, and the external about six or seven millimetres (three lines) from the outer margin. As these muscles are in the horizontal plane of the eye, their action is to move the globe inward toward the nose, or outward; or when both the internal recti muscles contract at the same time, the eyes converge, as is always necessary when any near point is observed.

In the act of accommodation the most important part is taken by the ciliary muscle, which, as we know, surrounds the crystalline lens, and when this muscle is used alone it simply focuses that one eye. But there is a most intimate and constant relation between the two ciliary muscles and the recti, so that every act of accommodation is accompanied by a certain amount of convergence when both eyes are used. It may be worth while to illustrate this elementary fact by a simple experiment: If I close my left eye, looking with the right at some distant object, the ciliary muscle and the internal recti of the right eye are, for the time, entirely at rest. If with the left eye still closed I approach the point of a pencil near to the right, the ciliary muscle alone is called into play. This is accommodation, and accommodation only, the principle of which has been already explained. Let the same thing be done with both eyes open, looking at some object twenty or more feet distant, the axes of both eyes are parallel and the ciliary muscles at rest. Now, let a pencil point be brought near to the eyes again; the nearer it comes, the greater the effort to see. In this act there occurs not only accommodation as before, but something in addition; that is, convergence of the visual axes. As the relation between convergence and accommodation is most intimate, it is necessary for us to make a slight digression to learn how it is measured, and how it may vary when the eyes are either far-sighted or near-sighted. In other words, let us consider for a moment what is known as the amplitude of convergence, and we can then understand better what may be expected in any test for the "insufficiency" of the recti muscles.

It is evident that when a person with normal eyes looks at a distant object the axes of vision are parallel, but the nearer that object

approaches the greater is the angle at which these axes of vision cross, until the maximum is reached at the point where fusion of the image is no longer possible. This range of convergence from parallelism to the maximum angle at which the axes cross is called the range or amplitude of convergence. Now, in order to measure this conveniently and to express it in figures a standard was long ago proposed by Nagel in what he called the metre angle. This consists in nothing more than taking as the standard of measurement the amount of convergence which a person with normal eyes exerts when an object is placed one metre distant from the eyes. If the object be approached to within half a metre of the eyes, then double the amount of convergence is necessary, or we would say there is a convergence of two-metre angles; if at one-third of the metre, then the convergence is three-metre angles, etc. As there is a relative range of accommodation, so is there a relative range of convergence, determined in an analogous manner, the details of which, however, it is unnecessary for our present purpose to consider.

This is the principle of the measurement. It is only to be mentioned here that while the normal eyes in early life can be accommodated to a distance of eighteen or twenty metre angles or more, there are variations in this dependent somewhat on the condition of the refraction. Thus the far-sighted person, having the eyes shortened and the internal recti muscles highly developed, can exercise a greater amount of convergence proportionally than normal, and, on the other hand, the near-sighted individual, having the eyes elongated and the internal recti muscle usually weakened, is not able to converge to as near a point as the emmetrope. A tape measure marked with centimetres on one side, and on the other with the corresponding metre angles is now sold by nearly all opticians.

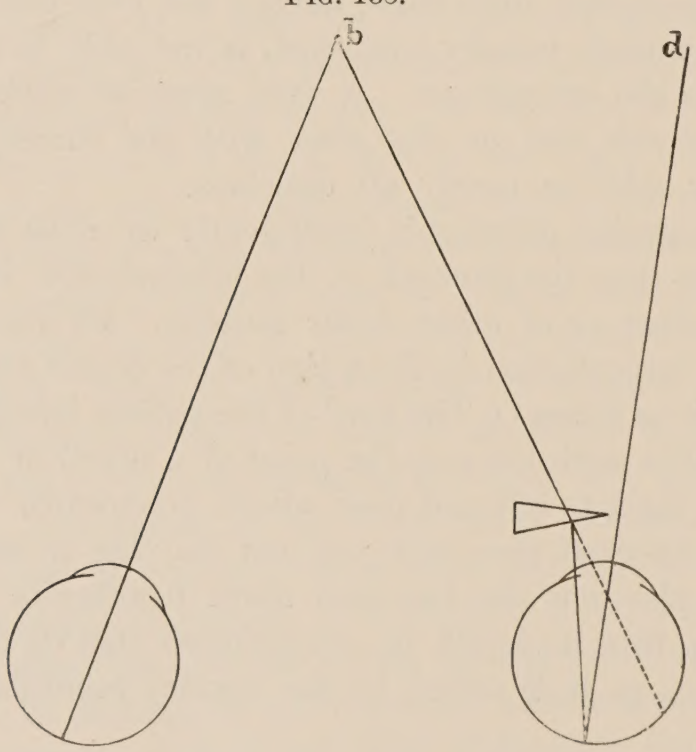
To treat muscular asthenopia intelligently we must know not only how to express thus the strength of the internal recti, but to detect a weakness of those or of other ocular muscles. Of the four methods of testing any imperfection in the action of the ocular muscles, the first and simplest is as follows: The head of the patient being held erect, he is asked to follow with the eyes the point of a pencil or other object as it passes from right to left and from above downward. In doing this it should be observed that each eye not only has a natural range or mobility, but also that the two eyes move together in all directions. In attempting this it should be remembered that on the average the field of fixation, as it is called, in the normal condition is as follows (Landolt):

Outward, 45–50 degrees;	Inward, 45 degrees;
Upward, 35–40 degrees;	Downward, 60 degrees.

There are various appliances for determining any limitation of the motion in one or both eyes in any given direction, but in general the observer is able to distinguish this by noticing whether or not the outer edge of the cornea reaches the canthus on the outer side, for example, when the eye is turned outward as much as its fellow, or whether the inner margin of the other cornea reaches the inner canthus; in other words, whether the movements of both eyes are exactly the same with regard to some definite fixed point. It should also be noted, in this connection, whether the two eyes converge equally. It is sufficient to hold the point of a pencil a few feet in front of the patient, exactly in the median line, and then gradually approach it, directing the individual to regard it intently. As he does so of course both eyes turn inward, and if the act is accomplished in a perfectly normal way, there is no difference in the movement of the two. They both converge to a certain point, varying somewhat with the age and muscular strength of the patient, and then, when single vision is no longer possible, both eyes turn outward at the same time, while usually the patient complains of the feeling of discomfort and fatigue. But if insufficiency does exist, then, when the object is held at a distance of seven or eight centimetres from the eyes in the median line for a few seconds, the internal rectus, which is weaker than normal, relaxes its effort, and the eye turns outward.

A second test consists in measuring the ability of the muscles to

Fig. 135.



overcome prisms: If a person with normal eyes looks at an object in the distance, and holds a prism of, say, five degrees, with the base in,

before one eye—the right, for example—then, inasmuch as the ray from that object passing through the prism is bent inward, it becomes necessary for the individual to turn that right eye slightly outward in order to meet the entering ray, and in doing so he contracts the external rectus of that eye more than usual (Fig. 135). If the prism selected be a very strong one—so strong that it is impossible for the external rectus to draw the right eye out far enough to meet the entering ray—then that ray, falling to the nasal side of the retina, and being projected outward, causes the patient to see double—one image in its natural position, of course, with the left eye, and the other image projected apparently off to the right. With a little trial a prism can be found, perhaps ten or twelve degrees, which is just sufficient *not* to produce double vision, the strength of that prism expressing the ability of divergence. In a similar manner can the relative strength of the other recti be stated in figures, or the same result would be produced if, instead of holding a prism before one eye alone, one of half the strength were held before each eye. It should not be understood that there is any prism which measures definitely the normal strength of either pair of recti muscles. There are, indeed, in apparently healthy eyes remarkable variations of ability to overcome prisms placed in certain positions. A considerable number of observations, however, made by Schell and others have shown that an emmetrope has a power of adduction (convergence) of about thirty degrees, and of abduction (divergence) of eight degrees, the average ratio being one hundred to twenty-eight. With the hypermetrope we might expect that as the necessity for accommodation is greater, so the power of convergence would be also proportionately greater than with the emmetrope, but, on the other hand, it is usually less, the power of adduction being about twenty-five degrees, of abduction twelve degrees, and the average ratio between them one hundred to forty-eight.

FIG. 136.

The test for muscular insufficiency which is usually considered the most exact consists in holding before the patient at the ordinary reading distance a fine perpendicular line having a dot in its centre (Fig. 136), then placing a prism of four or five degrees with the base down or up before one eye, and noting the effect. Let us suppose, for example, that such a prism with the base down has been placed before the right eye. What happens when the patient looks with both eyes at the dot? With the uncovered eye he looks directly at it of course, but the rays passing through the prism are bent downward toward its base, and the individual seems to see with the right eye the dot and its line above the place which it naturally occupies. If, now, the eye in a state of rest is directed exactly toward the object—in other words, if there is no undue convergence or divergence—one dot seems to be immediately

above the other; there is apparently one long vertical line with two dots in it. If, however, the eye tends to turn inward when such vertical diplopia is produced, then the upper image will be projected somewhat toward the right side—"homonymous" diplopia. If the right turns outward, then a corresponding "crossed" diplopia is produced. Now, by placing another prism with the base turned either outward or inward before the first prism used, it will be possible to bring the upper line and dot directly over the lower one, and the strength of this second prism will represent the amount of deviation inward or outward.

The tests given above indicate with more or less precision the degree of so-called weakness or insufficiency of one pair or another of the recti. It must be admitted that we have no method of estimating the strength of these muscles which can be compared in exactness to the results obtainable by spherical or cylindrical lenses in measuring the refraction. Still, in spite of these objections, theoretical and practical, in any given case of asthenopia, if a perfect correction of all errors of refraction is not followed by improvement, it then becomes a question of assisting the recti muscles by means of prisms. This is, to a certain extent, to be ascertained merely by trial, but the tests given above, if not separately to be relied upon, altogether give valuable indications which muscle is at fault and the degree of its insufficient action.

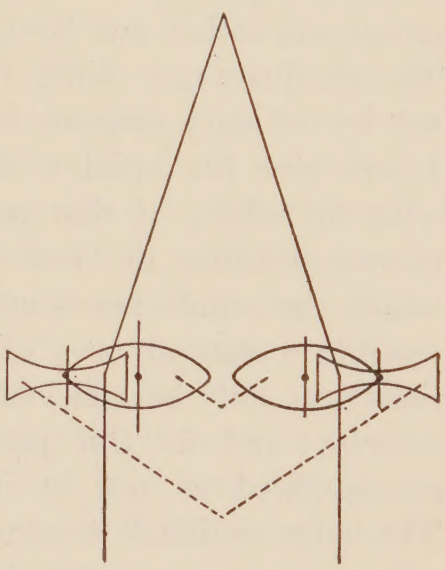
In this connection mention should be made of the nomenclature which was proposed by Dr. Stevens of New York in the *Archives of Ophthalmology* for expressing degrees of muscular weakness, and which, to a considerable extent, is used in America. Dr. Stevens proposed to call the tendency of the visual lines to parallelism orthophoria, and their tendency to some other direction heterophoria. This latter he divided into three classes—esophoria, a tendency of the visual lines inward; exophoria, a tendency of the lines outward; and hyperphoria (right or left), a tendency of the right or left visual line to place itself in a direction above that of the opposite side, etc.

Having ascertained by these tests that a certain amount of insufficiency of one or more muscles exists, and having also measured its degree, we come to the direct question as to how that condition is to be treated. It is taken for granted that any error of refraction has already been corrected by a proper glass in accordance with the principle of keeping the positive part of the relative accommodation proportionally greater than the negative part, as already stated. And now the same principle must be kept in view with regard to any prism which may be prescribed either alone or in conjunction with such a spherical or cylindrical glass. For muscular asthenopia the prism prescribed must be of such a strength as to give to the eyes as nearly as possible such a relative range of the convergence as they have when in a nor-

mal condition. It is not easy, however, to carry out the details of this principle in every case, and it must be confessed that a considerable amount depends upon the peculiarities of the individual—a variable factor which is to be ascertained only by trial. It is rather exceptional also that we find cases of muscular asthenopia alone; in other words, those in which the inconvenience is entirely removed by the use of prisms only. A large proportion of these individuals suffer from an asthenopia partly of the accommodative and partly of the muscular variety. For such persons glasses are often required having a curved surface on one side of the spectacle and a prism on the other. The opticians set these in such a way as hardly to attract any attention, and the patient simply knows vaguely that his glasses differ in a way from those of most others.

Although this same principle of the double glass must very frequently be applied where there is a combination of accommodative and muscular asthenopia, it is possible by a very simple device to obviate the necessity of this compound glass, thus saving the patient considerable annoyance and expense. This is accomplished merely by decentring the lens, either toward the nose or toward the temple as may be necessary. If the patient is required to use a convex spherical glass, and if the centre of that be displaced outward toward the temple, then it is evident that when he looks through the inner marginal portion, as he would do in turning the eyes toward a near object, he would obtain the effect of a prism which has its base out, in addition to the effect of the lens itself, or if the centres of the spectacles are displaced toward the nose the effect of a prism with the base inward is produced, as shown in Fig. 137. Conversely, if he requires concave glasses, and if these be decentred outward, he would obtain the effect of prisms with the bases inward, as shown in Fig. 137, or if the centres be displaced inward the effect of prisms with the base outward.

Fig. 137.



If in a case of asthenopia no relief is obtained by prisms or other means thus far suggested, the question arises whether it is not possible to strengthen the weakened muscles by prolonged rest or by judicious exercise. In considering the former, we should clearly distinguish between attempts at obtaining rest which are rather injurious than otherwise, and such a real and complete rest as can be obtained by the use of a mydriatic, preferably atropine. Many a far-sighted person begins

his work requiring exact accommodation, such as reading, writing, or bookkeeping, without difficulty, and finds that the fatigue increases slowly toward the end of the day. A night's rest brings relief, but again the freshness of the morning is followed by fatigue at night. The same observation, on a little larger scale, is made when the first of the week is compared with the last. Many a patient, having experienced this, draws the conclusion that only a still longer rest is required to give permanent relief. The principle is good, but the application is too often faulty, for long-continued idleness is not rest in the true sense of the term. Persons may abjure reading or similar work, but if the muscles of the eye are in their ordinary condition a certain amount of accommodation and convergence is required as often as a near object is viewed, whether for a long or short time. If one looks at the title of a book, a line in a paper, or other object, and the eye is accommodated and converged even for an instant, the same strain is required, and there is the same tendency to keep these faulty muscles in action and to continue the condition of irritation or fatigue. The disadvantages which result from such a useless attempt to obtain rest by ordinary methods have been so well expressed by Carter that I here give his opinion in his own words: "We often have to deal with the effects of that most pernicious of all recommendations, the recommendation to 'rest the eyes,' and consequently with organs of which the whole nervo-muscular apparatus has been brought by disuse into a state at once of debility and of excitability. Such conditions can only be relieved by careful strengthening of the weakened muscles; and for this purpose the employment of the eyes must be so regulated as not to impede nutrition by occasioning fatigue." The only rational treatment theoretically would be to shut such a person up in a perfectly dark room. Fortunately, however, we are able to accomplish the desired purpose, without any such imprisonment, by means of belladonna. By the use of one of its salts, the sulphate of atropine, the ciliary muscle can be placed entirely at rest. It should not be understood that a single application of a weak solution is always sufficient to do this. In exceptional cases it is necessary that a quite strong solution be used, perhaps for a week or two, when, to the surprise of the unexperienced, a decided relaxation of the ciliary muscle takes place, or even an apparent near-sightedness due to spasm of that muscle is changed to far-sightedness. When perfect rest can be obtained it is without doubt an advantage, while the partial rest, such as is given by those who simply attempt to do nothing, is not only to a certain extent useless, but in many cases a positive disadvantage.

In nervous subjects it is an excellent plan to use atropine at once for a double purpose—to make the first examination as complete as

possible, and also by this relaxation of the ciliary muscle to gain the rest which that and perhaps also the internal recti demand. If the amount of asthenopia is very slight, one or two instillations for the purpose of examination are sufficient to place the muscle entirely at rest, and often that will enable the patient to begin any systematic exercise of the muscles with vigor and with success. If, however, the ciliary muscle does not relax entirely, it is necessary to continue the atropine one or two days before this relaxation is accomplished. In just such cases it is advisable to continue instillation of a weak solution for a few days or even weeks.

In cases which require the use of atropine in order to determine the glass which is advisable, a few days' real rest is obtained, as has been said, by the very means essential to the mere examination. But, whether any such rest is possible or not, in almost all of the pronounced cases of asthenopia it is advisable to strengthen the eyes by means of judicious exercise. As the convalescent from typhoid fever or other exhausting disease requires rest and exercise in carefully arranged proportions, so are these to be advised for the asthenope as the peculiarities of the case demand. The exercise may be of two kinds —namely, that calling into play all the muscles which are used in the act of accommodation, and that exercising only the pair which seem to be specially at fault. The most reliable and simple means of giving exercise to all the ocular muscles at once is by adopting the method advised by Dr. Dyer, and now generally known as Dyerism. It consists merely in reading a certain definite small amount daily, and increasing that amount systematically as the strength of the eyes increases. The patient is directed to select a book with good type, and first ascertain by a few trials the average time he can read without any discomfort. This may be only a few seconds, five or ten minutes, or longer. Having determined this, the starting-point, the patient should endeavor to increase the amount regularly each day, at the same time using whatever glasses may have been prescribed, provided these give additional comfort. The amount of daily increase should be somewhat in proportion to the severity of the asthenopia. If pain is experienced within a minute or two, then it is a good rule to attempt the reading four or five times daily, adding a half or quarter of a minute each day—not at each sitting. If the pain does not appear until after five or ten minutes, then a minute daily may be added; if not until after twenty or thirty minutes, then two minutes; and so on. Of course these are arbitrary rules, but are those which I have usually found to serve very well. As the principle of this method is evidently the same as that employed by the gymnast when in training for rowing, walking, or exercising any other special set of muscles, so the ocular muscles are trained to undergo a gradually increasing amount of work.

During the training all other attempts at reading or efforts at accommodation should be omitted. This is especially the case during the earlier trials, but later, when the patient can read an hour or two without difficulty, then more latitude may be allowed in the choice of employment.

It occurs almost invariably that there are interruptions in this gradual increase of the time given to reading. After continuing the progress satisfactorily for a week or more, the patient suddenly finds that severe pain is experienced before the amount for that day is half finished. This need not be a reason for discouragement. The next day the plan can be resumed as if no interruption had occurred, or if this is impossible the patient will nevertheless find, when he is able to resume reading, that he can increase his daily measure of exercise four or five times as rapidly as before until he has regained the lost ground.

If we next ask ourselves how it is possible to exercise any one set of muscles more than another, the use of prisms is immediately suggested. When the existence of a muscular insufficiency has been established, the prisms usually prescribed are so placed that they tend to relieve all extra effort—in a position the reverse of that which they would occupy if the purpose were to give rest to the weakened muscles. Of course only the weakest prisms, those of one or two degrees, can be used at first, and those but for a few minutes at a time. But gradually they can be made stronger, and the time increased from a few minutes daily to half an hour or more as may appear best on trial. In this connection it is unnecessary to describe any of the various instruments intended thus to give exercise to certain ocular muscles, especially the internal or external recti. Most are based on the principle of the stereoscope, or are so arranged that the effect is increased or decreased by prismatic glasses placed easily before the eyes.

If all other methods have failed to relieve the asthenopia, it becomes a question whether the weakened muscle may not be strengthened by lessening the force of the one which is apparently too strong. It is out of place here to enter into any discussion as to the reasons why, theoretically, it is useless to make tenotomy of an abducting muscle in order that the adductor may have greater strength, or to inveigh against the almost indiscriminate tenotomies which some are accustomed to make. I am aware that no small amount has been written to show that asthenopia of almost any form, especially when the headache is severe, also obscure nervous symptoms, together with epilepsy and chorea, have been cured by these partial tenotomies, but I think the majority agree with Landolt that "we must confess that our knowledge of insufficiency and convergence is still in its infancy," and that "surgical intervention never requires more prudence and

delicacy than just in these cases of muscular insufficiency." It is true that in a few cases which have baffled all simpler methods good effects have been obtained by means of such tenotomies cautiously performed. The instances are now too numerous and too well authenticated to deny this. On the other hand, it must be stated that thus far we are ignorant of any unfailing test or tests by which these cases can be properly selected, and only in the really aggravated forms are we justified in an operative procedure. The difficulty, however, is not so much in the tenotomy itself as in the exactness in regulating the degrees in order to produce the result wished for.

We come, finally, to the treatment of central asthenopia—a term, like amaurosis, still found in use, but which, like the latter, is becoming so limited in its application that we all hope for a time when both may be eliminated from ophthalmological literature. They are to a great extent expressions of our ignorance. Amaurosis has been defined as a disease in which the surgeon can see nothing, and the patient can see nothing either. It is much the same with central asthenopia: the surgeon can find no perceptible cause for the asthenopic symptoms, but yet they exist. On the other hand, it must be admitted that there is a certain reason for the retention of this term.

The fact is simply this: Every practitioner encounters a certain number of cases, usually women, either of the wealthier and rather idle or aimless class or those weakened by overwork, who complain of the most typical symptoms of asthenopia. The vision is of course tested with the hope of finding the cause of the complaint in some error of refraction. But this gives only negative results, unless it be in the merest trifle of an astigmatism, while a test of the muscles perhaps gives absolutely no clue to any variation from the normal standard. Remembering that in occasional cases it is necessary to correct even a trivial amount of ametropia, it is customary with most to give a corrective glass for even this slight imperfection, making a provisional diagnosis of accommodative asthenopia; but the trial of such a glass shows what the surgeon at first suspected, that the asthenopia is of central origin.

As to treatment, the first indication of course is to remove any such special cause as may be found in the nervous system or in the condition of the patient in general. Naturally, the surgeon is led to inquire if there is any cause predisposing to hysteria in any of its multitudinous forms; indeed, after seeing a number of these cases it becomes a question if a classification should not be made including what might be called hysterical asthenopia. The sex, the mode of living, and the general condition of these patients would favor a suspicion of hysteria did we not find the same symptoms sometimes in robust men whose active occupations are such as render hysteria difficult to imagine in

connection with them. Indeed, while hysteria in some of its forms may be a complication which deserves first consideration in the treatment, still it is by no means invariably present. It is out of place here to go into many of the details which may be dwelt upon in connection with the treatment of these suspiciously hysterical women, but evidently the principle is to give more occupation to the idle and prescribe less work for those who have too much.

Other pathological conditions of the nervous system which may exist as complicating factors must of course receive due attention. Too much stress cannot be laid upon the necessity of carefully studying each case of central asthenopia to ascertain as nearly as possible just what is the variation from the normal standard of the nervous system, and, having established this, the treatment of that disease is also the treatment of the asthenopic symptoms of which such a patient complains. In this connection it would hardly be amiss if a short chapter were written on the hygienic measures to be adopted in restoring the patient to absolutely perfect health or as nearly so as is possible. Regular and sufficient sleep is essential; all forms of mental excitement should be avoided; business cares or the annoyance of domestic management given up to as great an extent as practicable. Rest of mind and body should be the rule—not a rule to be followed as a solemn duty, but rather as a pleasure. Not only is the nervous system to be regarded, but the perfect regulation of the digestive apparatus is often a factor of no small importance. Both simplicity in food and the regularity with which it is taken are to be observed. Stimulants are to be avoided, and even the drinking of tea or coffee and the use of tobacco restricted, if not, in special cases, entirely forbidden. Occasionally some of the saline waters are of benefit, and a stay at the baths or watering-places is followed by improvement. If the condition of the nervous system and the digestive organs calls for attention, care should also be given to an equal or even greater extent to the healthy development of the muscular system. Almost invariably exercise, and exercise in any of its forms, is beneficial. As walking is the simplest, so is it often the most efficacious method. Persons often averse to even a little exercise will, by gradually increasing the amount, become expert pedestrians, and to their surprise the amount of asthenopia decreases almost exactly in proportion to the degree in which they can increase the exercise. Other forms are also advantageous—either riding or such vigorous exercise as can be indulged in at a gymnasium. Indeed, I regard the gymnasium as an important aid in the treatment of this variety of asthenopia. Gymnasia for women as well as men are now established in all of the larger cities, furnishing thorough and intelligent methods of exercise, which can be followed with regularity in good weather and bad, in winter and in summer.

Where these are not to be found it is possible to improvise a gymnasium in every household by the erection of perpendicular bars, swings, etc., or at least the patient can use dumb-bells and clubs.

In this connection the advantage of cold bathing is not to be omitted. A morning dip in water at the temperature of from 60° to 65° F., with active friction of the body afterward, is also a hygienic measure of no small importance.

In the treatment of many of these cases of central asthenopia, pure or complicated with other forms of nervous disease, I have been forcibly struck by the advantage to be gained by what is termed "suggestion," or possibly by hypnotism. Carter and others have laid stress upon the fact that when these patients come to us discouraged by their long-continued pain and headaches, usually anæmic, often oppressed by the fear of impending blindness, a great deal is gained simply by the positive statement to the patient that blindness is not at all to be anticipated, and that by properly-adjusted glasses or a suitable regimen relief, if not perfect cure, can be expected. The moral effect of this assurance, which can be truthfully given, is an important factor in the rational treatment of these cases. Still more recently, since the practice of making partial tenotomies has come into vogue, it has been noticed that patients have been decidedly benefited where the incision was very slight. The relief to the patient can only be accounted for, I think, by the mental impression which such an operation produced.

Strabismus.

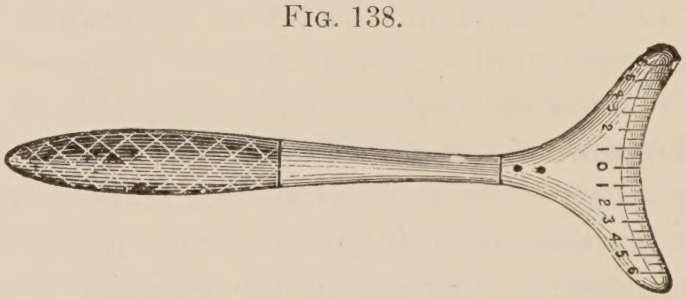
By strabismus, or "squint," we understand a condition in which the visual axes do not meet or tend to meet in the point at which the person looks. As far as the position of the eye is concerned, we speak of a convergent strabismus when one eye turns too far inward; a divergent strabismus, when it turns outward; sursumvergens, when one is directed upward; and dehorsumvergens, when directed downward. There are also different varieties of strabismus, defined according to the functional condition which exists. Thus—

Strabismus is *latent* when the individual is able to direct the two eyes toward the same object, thus fusing the images in a natural way and seeing one singly; but as soon as that effort is relaxed one eye turns from the position which it should occupy into that which it does occupy by preference. Any one of the varieties of strabismus just mentioned may exist in a latent condition, and not be apparent unless some special effort is made to ascertain its existence. Strabismus is also *permanent* or it is *intermittent.* When intermittent it appears only with certain positions of the eye or under certain other conditions. Finally, it is *alternating* when the individual has the power to focus the object with one eye or with the other at will. These are the differ-

ent varieties, but for practical purposes they all fall into two great classes—namely, what is known as optical strabismus and paralytic strabismus.

While the foregoing terms express the varieties of abnormal position, it is necessary that we understand also what is meant by the "primary" and "secondary" strabismus, and also know how the different degrees can be measured. The meaning of these terms can best be shown by an illustration: Let us suppose a case of convergent strabismus of the left eye. If the examiner place his hand before the left eye of the patient, partly covering it, and he be asked to observe with his right eye some object immediately in front, then on looking behind the hand the surgeon will see that the left turns inward to a certain point. Suppose a dot of ink be placed on the lower lid exactly under the centre of the left cornea in its converged position; now let the right eye be partly covered while the patient observes with his left the same object. Again, let a dot of ink be made on the lower lid under the centre of the left cornea. The distance between these two dots measures in a rough way the amount of the *primary* convergence, and we will suppose in the present instance that this distance is five millimetres. Now, reversing the process, let the right eye first be partly covered and the patient asked to observe with his left some object immediately in front, the position of the right cornea being marked with a dot; and again, the left being partly covered and the right directed to the object, a second dot is made on the right lower lid. The distance between these two dots measures the *secondary* deviation. We thus see not only what is meant by the primary and secondary squint, but also, in a way, how to measure the degree of the deformity in lines or millimetres. To obviate the inconvenience of dotting the lids with ink numerous strabometers are in use, the simplest of which is here figured and explains itself.

FIG. 138.



For the sake of convenience it is customary to speak of the degree of strabismus in such a linear measure as millimetres or lines. It should be stated, however, that while this is sufficient for practical purposes, it is not a perfectly accurate record of the amount of strabismus. In an exact statement we should speak only of the strabismus

in degrees of the arc of a circle, measured, for example, by reflection of the centre of the cornea or otherwise. A description of the various methods by which this is accomplished can be found in any of the textbooks on ophthalmology.

The division of all cases of strabismus into the two great classes of optical and paralytic is not only convenient, but it also rests upon a basis of facts which are of importance in regard to causation, and especially to treatment. We designate by "optical strabismus" a malposition of the eye which is associated with a fault in its refraction. To understand the reason of this it is necessary to refer again, briefly, to the intimate relation between accommodation and convergence. We must remember what has already been said when considering asthenopia, that if a person with normal vision looks with both eyes open at a distant object, both are entirely at rest, but if they be directed at a point a few inches in front, then, in addition to the act of accommodating or focusing of each eye for that point, there is also a turning in of each of the visual axes—namely, convergence; and we must remember that there exists an almost constant relation between these two acts of convergence and accommodation.

Let us suppose that instead of having a normal eye the individual referred to should be far-sighted. By this we understand not that he sees any better in the distance, but simply that when he attempts to look at even a distant object it is necessary for him to exert a certain amount of accommodation, and the nearer the object approaches the greater in proportion must be his effort at accommodation as compared with the normal eye. Now, inasmuch as accommodation and convergence always go together, it follows that the far-sighted person must exert a proportionally greater amount of convergence than does the person with normal eyes. In this way can the fact be accounted for which Donders established, that about 77 per cent. of the cases of convergent strabismus are also cases of far-sightedness. It would lead to too great a digression to discuss the difficulties which arise in this line of reasoning, but none the less do we find it well established that convergent strabismus is, in the large proportion of cases, the accompaniment of far-sightedness, and divergence of near-sightedness. These are not only facts which have a direct bearing upon the treatment, but which it would be well if intelligent physicians popularized more thoroughly among their patients; for too often do we find mothers inclined to fall into the superstition that this condition is produced by "fits" or worms or some equally irrelevant cause, whereas if the origin of these affections were generally known many children would have suitable glasses provided at an age when such assistance might afford relief.

Having thus glanced at the reason for the classification here given,

let us consider further the characteristics of optical strabismus, whether of the convergent or divergent form. These are—

First, in optical strabismus each eye alone can be turned in any direction as though it were normal; in other words, the arc of its excursion is not limited by any paralytic condition. For illustration, if one eye be closed and the patient be asked to look at the point of a pencil, he can follow this as it is moved inward, outward, upward, and downward exactly as though that eye were in a normal condition; and this is true of one eye as well as of the other.

Second, in optical strabismus the primary deviation is equal to the secondary, whereas in the paralytic form the secondary is greater than the primary. The reason of this it is out of place to consider here.

Third, another characteristic of the cases of optical strabismus is that this primary deviation is the same with relation to all positions in which the person looks, which is not the case in paralytic strabismus.

The person affected with the latter can so change the position of the eyes that in certain positions the axes are almost parallel; and this attempt of a subject of paralytic strabismus to obtain only a single image necessitates such a turning of the head as to make its position one of the characteristic points of the disease.

Fourth, the persons affected with optical strabismus are not annoyed by double vision. Whether the image in one eye is suppressed, or however this may be accounted for, the fact remains that except in certain recent and unusual cases the subject of optical strabismus sees only one image, although the eyes are not directed to the same object.

In considering in detail the various methods of treating optical strabismus it will be convenient to begin with the simplest and proceed to the more important but more effectual methods. These will therefore be taken up in the following order: (A) Mydriatics; (B) corrective glasses; (C) exercise; (D) tenotomy; (E) advancement.

(A) **Mydriatics for Strabismus Convergence with Hypermetropia.**—While there are some objections to be raised to the statement that convergent strabismus is dependent upon far-sightedness, the connection between the two is so far established as to make it practically the basis of all the means of correcting malposition up to the point where an operation is decided upon.

According to the explanation given before, abnormal convergence is considered to be dependent upon an excessive degree of accommodation. Were this invariably true, it would follow logically that if the accommodation could be placed at rest by relaxing the ciliary muscle, then the tendency to excessive convergence would also be relieved. This is not only theory, but there is a certain basis of clinical fact to support it. Now, we have a safe and convenient means in atropine by which to place the ciliary muscle entirely at rest. Accordingly, it was long

since urged that the simplest and easiest method for the treatment of convergent strabismus is thus to place the accommodation entirely at rest. In the very early stages, especially before the condition has become thoroughly established, the use of such a solution is not unfrequently followed by improvement. It is true that improvement also follows many cases where no treatment of any kind is attempted, as will be shown hereafter; but I think every one who has compared a series of cases in children in which atropine has been used with another series in which the strabismus has been left to itself will conclude that such a relaxation of the ciliary muscle is of decided benefit. So well is this established in the minds of the profession that it is generally considered a decided omission not to give a child under six or eight years the benefit of the doubt by such an attempt. A solution of 5 centigrams ($\frac{3}{4}$ grain) to 20 grams (5 drachms) of water dropped into the eye once a day is not only a painless and harmless remedy, but, as already remarked, is of service in so many cases that it is certainly worth the trial.

(B) **Corrective Glasses.**—As excessive convergence is associated with excessive effort at accommodation, so must we try to lessen this effort by glasses when the use of atropine is not sufficient to accomplish the desired effect, It must be admitted that such glasses are not without certain disadvantages. It is inconvenient even for an adult to be dependent upon artificial aids, and especially is it so for children. A piece of glass in front of the eye of a child who is frolicking about in boisterous games and bumping his head against projecting objects is a danger not to be overlooked. On the other hand, the advantage to be gained from the use of such glasses by children ten to fifteen years of age, or even for those older, far outweighs any reasons for their not being worn. It is impossible here to enter into details concerning the choice of the convex glasses. This is explained in the articles on accommodation and refraction. The principle to be applied here, even more strenuously than elsewhere, is that the patient should be given the *strongest* glass with which he can see in the distance as well as with the naked eye. If the correction be made according to the old rule which has come down to us from Donders, glasses should be prescribed even stronger than that—the rule being, as he stated it, to correct all the manifest hypermetropia and about one-fourth of that which is latent. Moreover, as the use of such a glass allows the ciliary muscle to relax, very frequently we find, after prescribing the strongest glasses which a person will wear, that at another visit a month or two later he will accept without difficulty another glass, perhaps two or even three numbers stronger. Not infrequently patients of an inquisitive turn, or those who come with an abundance of their own peculiar theories, are apt to object to this gradual increase in the

strength of the glass, or at first protest against wearing any. These objections need have but little weight, for if there is any fact well established in the treatment of diseases of the eye it is that for far-sightedness the stronger the glass that can be worn with comfort and with good vision the better. Especially does this hold true for glasses whose object is to relax the accommodation and thus lessen the excessive convergence. Another question that arises is to what extent shall these glasses be used. The patient asks, "Shall I use them only for reading, or for distant vision also?" In answer to this there need be no doubt, the principle being that the more they are used the greater is the rest to the ciliary muscle and the less the tendency to convergence. The patient should put on such glasses in the morning and wear them until he goes to bed at night. Many find it not only inconvenient, but they also do not like to make themselves conspicuous, and as an objection to the use of glasses at all is difficult to overcome, many will not consent to follow such instruction. The principle, however, should be explained, and the more the detail is carried out the greater the benefit to be expected from this plan. The use of atropine and of convex glasses, as has been so often repeated, is based upon the fact that as the accommodation is relaxed the tendency to excessive convergence lessens.

(C) **Exercise.**—We come now to consider another principle. It is that of attempting so to strengthen the weakened or relaxed recti muscles that they may become sufficiently strong to draw the eye to its proper position. Not infrequently a patient presents himself for examination of the eyes for some difficulty in no way related to strabismus, and in giving the history of his case he mentions incidentally that when he was a child, perhaps even during school-days, his eyes turned in very greatly—that this gradually decreased, and finally disappeared entirely. It will be noticed in these rather exceptional cases that, contrary to the general rule, the vision of each eye has remained good. What does this improvement mean? Simply that as the external rectus became stronger it was sufficient to turn the eye out to its normal position. Naturally it occurred to surgeons long ago to encourage these changes. We have already seen, in the portion of this article which relates to asthenopia, how a certain set of muscles may be exercised by means of proper prisms, and such prisms, properly placed, are often of much value. For the treatment of optical convergent strabismus, when used alone, the results are often unsatisfactory, except where the strabismus is of slight degree; but in conjunction with convex lenses, especially with young children or after an operation which has been only partially successful, the advantage of such prisms is constantly demonstrated by the good results following their use. In

speaking thus of prisms we may understand not simply such glasses set in the ordinary spectacle frames, but also those forming part of any one of the more or less complicated forms of apparatus designed to give exercise to weakened muscles. Several such instruments have been invented, the principle of the majority being that of the stereoscope, already explained in the portion of this article which relates to asthenopia.

(D) **Surgical Treatment of Strabismus.**—While the preceding methods of treatment are all excellent in their way, it is unquestionably a fact that division of the tendon of the contracted muscle is for the vast majority of these cases the quickest and the surest plan to be pursued. The first question which the patient or the surgeon naturally asks when an operation has been proposed is, "Is it safe?" and for all practical purposes the simple answer may be "Yes." Among the many thousands upon thousands of operations which are made constantly for strabismus, the literature contains only a few rare examples of accidents, and we can say that it is as safe to make this division of the ocular muscles as it is for a person to take an ordinary trip by rail. While such security can be assured, as far as any freedom from danger of severe inflammation is concerned, the patient should not be promised entire relief by means of the first operation; indeed, some surgeons like Pooley make the correction, as a rule, only partially at the first sitting by dividing the muscle of but one eye at a time, and Roosa says:[1] "I invariably inform my patients that from one to four operations will be required, and I only undertake cases when I am allowed to use my own judgment as to the propriety of a second or even third or fourth operation." This is an excellent plan, similar to one which I also follow: the surprise to the patient, if any, is a pleasant one, and with such qualifications the operation may be considered perfectly safe.

The question is also asked if the operation is painful, and, thanks to Koller for the discovery of the anæsthetic properties of cocaine, we can now assure our patients that the mere division of the tendon is hardly more than an inconvenience. If subsequent advancement of the muscle is necessary, or more complete tenotomy in occasional instances, with timid subjects it is worth while to give a general anæsthetic, but this is rather the exception. With young children, however, the case is somewhat different, and some form of a general anæsthetic is therefore advisable. In administering chloroform to children I have found more than once that the confidence of the patients can be gained by first applying a few drops of eau de cologne to the handkerchief or inhaler, and then gradually using less cologne and more chloroform until the child breathes only the

[1] *Results of the Operation for Convergent Squint*, p. 7.

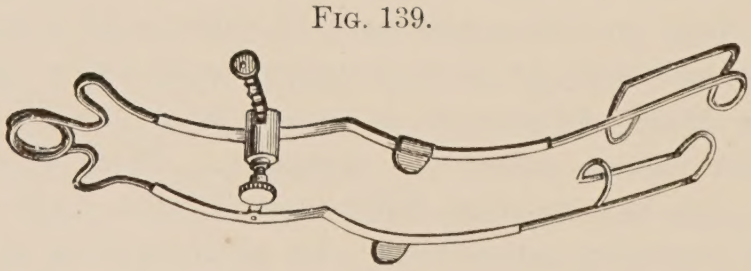
anæsthetic. Many a struggle I have thus avoided, and consequent anxiety and heartache has been saved to the parents.

Before considering the operation itself, in order to have a clear understanding of the principle on which tenotomy and advancement of the ocular muscles depend, it will be well to refer briefly to the important sheath covering the eye, whose anterior portion is known as the capsule of Tenon. This is all the more necessary for the reason that most textbooks on anatomy do not devote sufficient attention to this nor give its surgical relations to the muscles.

I know of no better way of describing that than to give the words of Wells in his admirable treatise on diseases of the eye. Speaking of the operation for strabismus, he says: "Before proceeding to consider this method of operating I would, however, dwell for a moment upon the anatomical relations of the muscles of the eye with the ocular sheath. Commencing at the optic foramen and loosely embracing the optic nerve, the sheath expands and passes on to the eyeball, which it encloses like a capsule. It is loosely connected with the sclerotic by connective tissue—so loosely, indeed, as to allow of the free rotations of the globe within it. At the equator of the eyeball it is pierced by the tendons of the oblique muscles, and, more anteriorly, by the tendons of the four recti muscles, with which it becomes blended, being finally lost on, rather than inserted into, the sclerotic close to the cornea. The posterior portion of the sheath, up to the passage of the tendons, has been called the capsule of Bonnet; the anterior portion from the passage of the tendons to its insertion in the sclerotic having been designated the capsule of Tenon. On piercing the capsule, the tendons of the recti muscles become connected with it by slight cellular processes, sent forth from the processes of the capsule."

There are but few preliminaries for the operation of tenotomy that need require the attention of the surgeon or arouse the anxieties of the patient. It is taken for granted, of course, that the vision of each eye has been exactly measured and recorded, together with the amount of

FIG. 139.

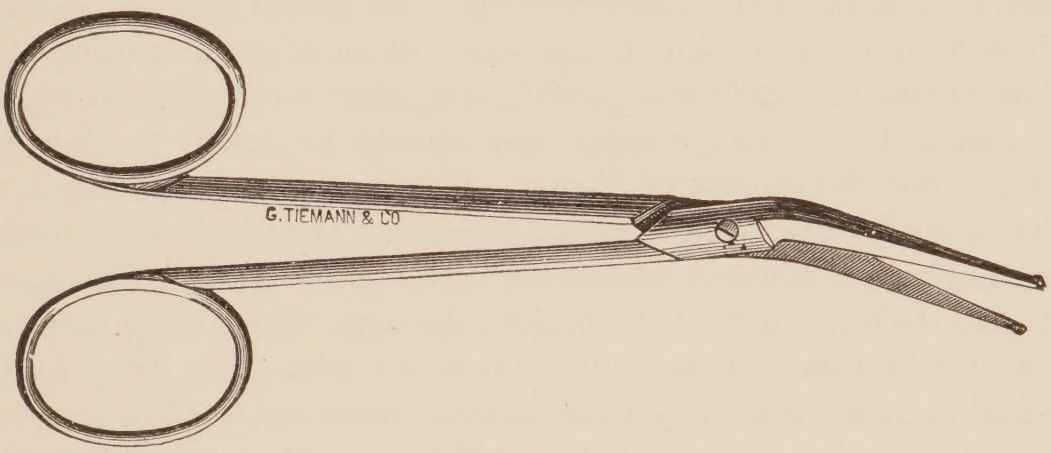


deviation, and that any peculiarity in the case has been carefully noted. In order to produce insensibility a solution of cocaine of 3 or 4 per cent. is dropped into the eye half a dozen times in about fifteen minutes. By the end of that time the pupil has dilated, and if the cornea

is touched with a bit of cotton or paper it will be found to have lost its sensibility almost entirely. Of course when a general anæsthetic is given the patient should lie down, and, although it is easy enough to make the operation on the adult while he is sitting upright, the reclining position is better.

The instruments necessary are few and simple. They consist of an eye speculum, a pair of fixation forceps, blunt scissors, two strabismus hooks, needle and thread with needle-holder. Of the speculum and forceps nothing need be said. The scissors, though blunt, should cut

FIG. 140.



easily quite out to the end, and if made a little smaller just at the point than in the blade the operator is able to divide the small

FIG. 141.

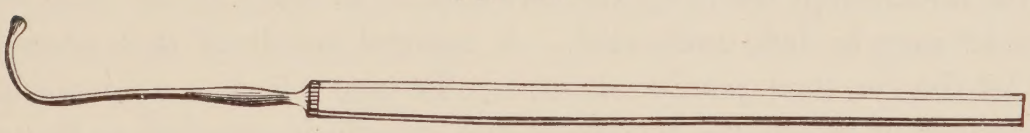
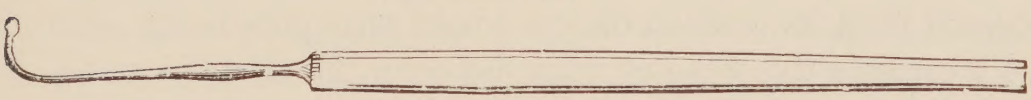
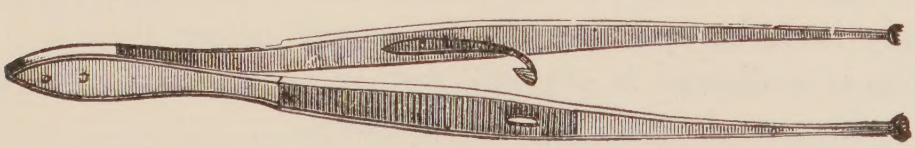


FIG. 142.



bands neatly and at the same time thoroughly. The strabismus hooks should be strong, but delicate, and the points of course blunt: indeed,

FIG. 143.



I think the tendency of late has been to make these instruments much smaller than a few years ago.

As to the technique of the operation, it is unnecessary to describe the varieties which have been in vogue, as it would only lead to con-

fusion. The most simple method is as follows: The spring speculum having been introduced to hold the lids widely apart, the patient is asked to turn the eye in a direction opposite to the muscle which is to be divided, in order that the tendon may come prominently before the operator. By means of fixation forceps the conjunctiva is then caught up at a distance of about four millimetres (two or three lines) from the edge of the cornea, and a vertical incision is made over the tendon of the muscle. If the strabismus exceeds two to two and a half lines, the blunt end of the scissors can be passed under the conjunctiva in order to loosen it from the conjunctival tissue covering the tendon and the capsule of Tenon. This is the first step. The second consists in raising the muscle by means of the forceps and cutting a small opening in its tendon, as near to the globe as possible and about midway in the tendon, from above downward: especial care should be taken to have this incision *within* the capsule of Tenon. Having made an opening in the tendon, a strabismus hook is passed upward. The fibres of the tendon, being caught, are divided *between the hook and the globe.* The same is done with the lower part of the muscle, the upper fibres being held with one hook while the rest are caught up in the other, this being usually sufficient to loosen it entirely from its attachment and to allow the eye to move outward, thus correcting the strabismus more or less completely.

Should this not result, it is probable that certain fibres of the tendon are still left undivided, as not infrequently they spread out in a fan-like attachment. In that case a few more drops of cocaine can be applied, and the hook swept freely up and down, so as to catch up any such small fibres as may be left undivided. A natural result of this procedure is to let the eye turn partly outward. To one who has not considered the manner in which the tendon of the muscle is attached to the capsule of Tenon it might be natural to suppose that when the tendon is loosened from its position the eye would turn quite in the other direction. Formerly this was just what did occur, for then the muscle itself was divided, instead of the tendon inside the capsule. But we must remember that as each muscle passes through the capsule it receives certain fibrous attachments holding the tendon and the capsule together, so that when the tenotomy is properly made these small bands referred to simply allow the tendon to slip a little farther back on the globe. If the capsule itself be opened wider above and below, then the muscle attached to it is allowed to slip still farther back, and in this way the degree of effect can be graduated with nicety.

Another method of operating is that proposed by Critchett, the object being to make a subconjunctival division of the tendon. In order to accomplish this Critchett recommends a small opening in the conjunctiva near the lower margin of the tendon, the incision extending also through the capsule, and, passing the scissors through the same

opening, along the edge of the hook, the tendon is divided in such a way as to produce but little laceration of the conjunctiva. Liebreich has also introduced a modification of Graefe's operation, whereby the hook, entering the lower edge of the insertion of the muscle, does less damage as he thinks, to the subconjunctival tissue. The opening is then closed with a suture. But the principle is the same in all, the amount of correction being dependent upon the more or less extensive opening which is made in the capsule.

The first question which arises in the mind of the operator after a tenotomy is, "Has the correction been sufficient, or is it excessive?" With the present advantages of cocaine it is advisable, as soon as the section is made, to have the patient sit upright and direct him to look at an object immediately in front. The usual tests for strabismus can then be made in order to see what degree, if any, remains. If the amount is only slight, it is sufficient to enlarge the opening in the capsule, thus increasing the effect on one eye only. Most operators, however, agree with Wells, who says that if the amount of convergence originally exceeds four or five millimetres (two to two and a half lines), or, according to Landolt, fifteen degrees, then it is better to make a partial correction on each eye, rather than all on one eye. In any event, it is preferable to delay the operation on the remaining eye for a day or two in order to ensure no over-correction. In cases of excessive convergence it is necessary not only to divide the tendons freely on each side, but also to make very free incisions into the capsule of Tenon both above and below. In certain rare cases it is possible to lay bare the sclerotic of both eyes, so that it can be seen over an arc of at least forty-five degrees, and still, when these large wounds heal, there is hardly enough correction to make the axes parallel. If free division of the tendons on both sides is not sufficient, the effect can be still further increased by introducing a stitch in the conjunctiva opposite the outer margin of the cornea, and, drawing this tightly, attach it to the temple by means of a piece of court-plaster (Graefe) or to the outer canthus (Knapp). During the process of healing the patient can be instructed to turn the eye frequently in the direction opposite to the divided muscle, in order to keep the wound open as freely as possible.

Let us suppose, however, that the effect of the operation is too great. This would be indicated by a slight tendency toward divergence when the patient looks at a far point, or by inability at convergence. What is to be done in that case? The simplest and easiest method is to introduce a conjunctival stitch in the wound, or if this is not sufficient the stitch can be passed from near the edge of the cornea down beneath the conjunctiva, reaching to the capsule of Tenon or even to the muscle, which then is retracted backward.

Tenotomy of the opposing muscle may also be necessary, either at that sitting or later. Ordinarily, it is better to advance the muscle which was originally divided, as will be described later.

As the immediate result of the operation there may with propriety be a trifling amount of convergence, perhaps of two or three millimetres; indeed, in young subjects this is rather an advantage than otherwise, for the tendency later is invariably for the eye to turn outward, but there certainly should not be divergence or the least appearance of it. As we shall see a little later, it is easy enough to increase the effect of a strabismus operation, but when this has been excessive it is by no means an easy affair to counteract it some weeks or months later.

The after-treatment of a tenotomy is exceedingly simple. A wash of corrosive sublimate, 1 part to 6000 or 8000 of water, can be applied often enough to keep the wound free from any secretion which may collect, or any other reliable antiseptic lotion acts quite as well. The two desired objects are cleanliness and rest. Patients can go about almost immediately after, and can use the other eye pretty much as is desired. Fortunately, since the introduction of antiseptics patients "take cold," as they imagine, in such wounds seldom or never. I have known a patient go immediately from the infirmary, where a tenotomy was made on each side, to the large rolling-mills where he was at work, exposing both eyes to the glare of molten iron from eight to ten hours a day, and when he returned to the infirmary, nearly a week later, the eyes, though of course somewhat inflamed, were well advanced toward healing. Such examples show what an amount of exposure the eyes will bear without detriment after this operation.

It will often save considerable anxiety to the patient if the surgeon explains to him the different stages through which the eyes pass. There are three such stages in the process of healing before the final position is reached. The first is immediately after the operation. As has been stated, the axes should then be practically parallel or there should remain only a slight convergence. Supposing the operation to be performed, this first stage lasts a week or two before it passes into the second. As soon as the muscle has attached itself in its new position it begins, of course, to act with the full force to which it had been accustomed, and, being unusually well developed and active as compared with its opponent, it tends to draw the eye inward, and there results a considerable amount of convergence. This is often disappointing to the patient, who imagines that the difficulty is only partly corrected. After such a convergence has lasted some weeks or perhaps a few months, then there comes the third stage, during which his eye has a tendency to turn outward again. Usually it continues to be drawn gradually farther and farther outward, until it resumes the position in which it was left at the time of the operation. This is the final stage.

In this example I have taken the tendon of the internal rectus upon which to illustrate the details of the operation for tenotomy, that muscle being the one most frequently chosen for this operation. But the same principles hold good so far as the other recti are concerned, and the variations are only in such details as are readily suggested. Indeed, since so much stress has been laid of late upon asthenopia being due to a tendency of the eye to turn upward or downward, we see not a little of the division of the tendons of the superior or inferior recti.

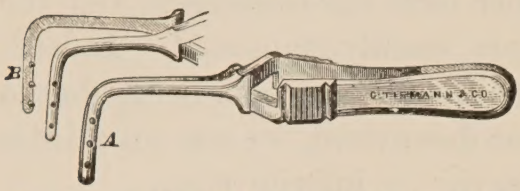
It should not be understood that the treatment is completed when, by operation or otherwise, the eyes are brought into a position of parallelism. Unless the vision of each eye is sufficiently acute to require that both be fixed simultaneously upon one object looked at, there can be no assurance that a result, however perfect apparently, will be permanent. As in all cases of strabismus the vision of one eye is usually more or less imperfect, so is it desirable after operation to improve this by suitable glasses or by exercise as much as possible. It is interesting also to note that when a highly imperfect eye is thus made to take part in the act of vision, it often improves to a considerable degree.

(E) **Muscular Advancement.**—We have thus far considered the treatment of strabismus by means of tenotomy alone. Instead of loosening the muscle on one side, it was long ago ascertained that good results could also be obtained by muscular advancement. In the majority of cases this is undertaken on account of a divergence—either such as has resulted from an operation for convergence, or for a divergence such as is found associated with near-sightedness.

As far as the preliminary steps are concerned, these are virtually the same as though an operation for tenotomy were to be made. To the instruments there should be added a clamp for holding the muscle, the use of which will be explained later, and as the pain is quite severe, chloroform or ether is often necessary. The technique of the operation for advancement is as follows: First, the conjunctival incision. This is made over the tendon of the muscle, its direction being from above downward. Second, an opening is made in the capsule of Tenon at the lower margin of the tendon, and under this is passed one of the branches of the toothed forceps. The instrument originally used for this purpose was three or four inches long, and of course so heavy that it could not be allowed to hang in place. If it happened that the patient struggled or if he vomited at the critical time, it was necessary to loosen the hold on the tendon, which had been obtained with difficulty, and either the progress of the operation was much impeded or no small risk incurred by traction on the muscle. To obviate this embarrassing difficulty it occurred to me to have these advancement forceps extremely light, each blade being only about an inch and a quarter

in length, but the part that holds the muscle toothed as in the older pattern. In placing any such forceps in position it is easier to slip the smooth branch beneath the muscle than the one with the projecting teeth; and to accomplish this, if the operator has only one such instrument, the smooth blade can be passed under the tendon from above, if not from below; but after once in place the tendon can be divided between the blade and the globe, and the instrument can be allowed to remain undisturbed as long as desired. The third step consists in the introduction of the stitches, and in this it is often convenient to have the threads of different colors and the needles strongly curved. The first one passes from the conjunctiva next to the cornea, behind the muscle itself, as nearly as possible in its middle point. The path of this stitch in the conjunctiva is from without inward, and then through the tendon from within outward. This thread should be of strong silk, and can be left loosely in place or the ends simply knotted to prevent confusion later. After this another curved needle with silk is introduced near the upper edge of the tendon from without inward, and after being drawn through is then passed under the conjunctiva, emerging two or three millimetres from the edge of the cornea, quite as far up as the highest point, and the ends of this thread are loosely knotted. Finally, the third stitch is introduced near the lower margin of the tendon, again from without inward, and again passed beneath the conjunctiva, emerging about the same distance from the lowest portion of the cornea. The fourth step consists in the removal of the muscle-clamp and the tightening of the stitches. If, however, it is desirable to produce a correction of more than four or five millimetres, it is better to make a small resection of the muscle, cutting away not only the part which has already been compressed by the clamp, but more or less of the additional portion of the tendon itself. In tying the stitches it is most convenient to secure the central one first, and then to tighten equally the one above and below, so that by this act the globe is not tipped either way out of place.

Fig. 144.



Dr. Lucien Howe's Advancement Forceps.

The above is one of the simplest forms of advancement, although I have found that a modification of the method proposed by Dr. Prince, though more difficult in its details, gives rather better results. Some operators, however, prefer to dispense with the clamp altogether, making the first step as here described, and in the second, after lifting up the muscle on an ordinary strabismus hook, three stitches are passed through it, or perhaps one on the upper edge of the tendon and the other on the lower, and these stitches serve to hold the tendon in place while the further steps are accomplished virtually in the manner mentioned.

Frequently there is considerable swelling of the conjunctiva at the end of the first and second days, perhaps sufficient to hide the stitches entirely. But a weak antiseptic lotion—for instance, sublimate solution 1 : 10,000—is sufficient to keep the wound clean, and frequent cold applications reduce the pain, though small doses of an opiate are occasionally necessary.

A word should be added in regard to the amount of correction necessary for advancement and the disadvantages which tend to follow this operation. With simple tenotomy it is sufficient to bring the eyes to a state of parallelism or make only a slight under-correction. With advancement, however, it is necessary to make considerable over-correction, turning the eyes to an angle of at least ten or fifteen degrees beyond the point which is desired.

It is on account of this tendency of an advanced muscle to slip back from the point at which it is at first attached, no matter by what method, that most surgeons invariably combine this operation with tenotomy of the opposing muscle.

Even when this is done also the average of the results is not as satisfactory as the simple tenotomy, and in general it must be regarded as a much more difficult and important undertaking.

Another method of advancement which should be mentioned consists in simply folding in the tendon of the muscle by a stitch passing from the conjunctiva near the cornea outward beneath the muscle. Where only a slight effect is required, this alone or combined with tenotomy will be sufficient, but the cases are rare, and it has the special disadvantage of leaving an unsightly scar.

Paralysis of the Ocular Muscles.

On reading the chapters in the various textbooks on paralysis of the ocular muscles the student cannot fail to be interested in the beautiful exactness with which it is possible by proper tests to locate the precise muscle which is at fault. Thus, the diagnosis of the existence of these paralyses has been brought to so great a state of perfection that there is a temptation to indulge here in a digression sufficient to give a glimpse of the methods by which this is arrived at. But, unfortunately, our knowledge of therapeutics concerning these paralyses has not advanced to the same degree, and in confining our attention to that we will consider first the removal of the causes producing the paralysis; second, prisms; third, electricity; fourth, passive motion; fifth, the general health.

As the first step in rational treatment is the removal of the cause, so in every case of paralysis of the ocular muscles it is necessary to ascertain as nearly as possible what produced it. We should ask ourselves, Is it due to a hæmorrhage in the brain, to an effusion, to a

gumma, an abscess or other form of brain tumor, to aneurism or abscess in the orbit? Again, is it due to pressure of bone as the result of accident or as a pathological growth on the interior of the cranium, or is it an accompaniment of syphilis or diphtheria, or of some other of the general diseases accompanied by local paralyses?

Of course the probability of the existence of each of these causes must be weighed, either as existing alone or in conjunction with others, and the relative importance of each factor decided by the peculiarities of the case.

This part of the treatment depends so much upon the separation of the various elements of disease causing the paralysis that the good judgment and skill of the practitioner will nowhere be taxed to a greater extent than in weighing well the conditions presented. It should be remembered that syphilis is by far the most frequent cause of all such paralyses.

Second, the use of prisms. The principle involved in the use of these has been described at sufficient length to render it unnecessary to enter into any further detail here. As the paralysis produces double vision, which can only be corrected by prisms, so if prisms be prescribed whose strength is little less than those which would be required to produce single vision, in the given case there will consequently be a corresponding effort on the part of the eye to turn nearer its proper position, thus giving a certain amount of exercise to the weakened muscle. Such prisms are worn more or less for a few weeks or months until the previously weakened muscle regains its strength, when the strength of the prism can in turn be lessened, and thus by repeating the same process the muscles become correspondingly stronger. This method, though excellent in theory, is not as practical as would appear, though of too much importance not to be given a thorough trial in almost every recent case.

Third, electricity. As the use of the constant or interrupted current has been found of advantage in the treatment of paralysis of other portions of the body, so has it long been employed for paralysis of the ocular muscles. It is unnecessary to go into details to elaborate this phase of the subject. That would involve not only the description of suitable batteries and electrodes, but the methods of application, and as it is the object of this article simply to furnish indications for the treatment, it need only be said in passing that for the paralysis of the ocular muscles it is ordinarily better to use a very weak interrupted current, and to apply one electrode behind the ear while the other is placed over the muscle.

It must be said of the use of electricity in this connection that while it is frequently employed, it is often more because everything else has been tried and failed than because it has produced very brilliant results.

The patient can usually be taught to use the battery himself, and in this there can be no harm if attempted with certain restrictions, and it may possibly do some good, but comparatively few practitioners rely upon it with any degree of confidence.

Fourth, passive motion. Several years ago it was ascertained by Michel that passive motion of the ocular muscles was often attended by at least a temporary return of function, as with muscles in other portions of the body. Since the introduction of cocaine this is not a painful procedure when used for the eye. The tendon of the paralyzed muscle being seized with a pair of fixation forceps, and the eye forcibly rotated in the opposite direction half a dozen times or more, it not uncommonly happens that the amount of diplopia is perceptibly lessened for a time, and by repeating the process we find that gradually the muscle regains more of its strength. Like the use of electricity, it is worthy of a trial, although by no means reliable.

Fifth, operation. When a muscle has lost its motion partly or entirely and deviation of the eye results, the question naturally arises if that cannot be lessened by advancement of the muscle or tenotomy of the opponent muscle. Experience, however, shows that operation in these cases is to be deprecated. If the strength of the opposing healthy muscle is lessened, the eye is apt to project, thus producing a deformity of another kind. Tenotomy, therefore, of the opposing muscle is not to be considered, except in certain rare cases. Nor is advancement of the paralyzed muscle to be regarded with much greater favor. Certainly not, if the case is one of recent origin, at least not until all simple methods have been tried, and until the patient has the benefit of the doubt that perhaps improvement may occur in the course of time. If the weakened muscle be shortened, and subsequently regains a certain amount of its tone, there unfortunately results a deformity and discomfort from double vision of the opposite form quite as great as that which it was the object of the surgeon to correct.

NYSTAGMUS.

We come, finally, to the therapeutics of nystagmus, and, although this is interesting from an etiological and diagnostic standpoint, there is but little that can be said in regard to our actual knowledge of a reliable method for the treatment of the large majority of these cases. It is essential, however, that we separate them into three different classes according to the causes upon which they depend. At least this division of the cases proposed by Kügel has been followed quite generally, in spite of the fact that the dividing-lines between the classes cannot always be easily drawn. There are—

First: Cases which are essentially those of strabismus, usually asso-

ciated with ametropia, and complicating this strabismus we find more or less pronounced nystagmus.

Second: The nystagmus is associated with changes in the interior of the eye which, like the disease we are considering, are congenital, and when the ophthalmoscopic examination is made we find ordinarily alterations in the choroid or in the retina and optic nerve.

Third: There is a class in which there is no strabismus or ametropia, and no changes in the interior of the globe, and for lack of a better term they are usually known as cases of nystagmus "of central origin."

For the first class it is possible to produce an improvement according to the character and degree of ametropia when suitable glasses are adjusted; also the strabismus, which is ordinarily of the convergent form, can be corrected by means of an operation, as indicated above, and thus not only is the vision made somewhat better, but the deformity considerably lessened. Up to this point in these cases, which, it must be confessed, are rather exceptional, we can expect improvement, but anything like cure is entirely out of the question. Various methods have been suggested which it is unnecessary to detail here, such as division of one set or another of the ocular muscles which are supposed to be at fault, but even in these, the most promising cases of nystagmus, the result at best is only an improvement. As far as the second and third classes are concerned, there is virtually nothing to be done for them. Different trials have been made to test the value of electricity or internal treatment, but practically it can be said in a few words that this spasmodic contraction of the muscles of the globe, especially in cases of the second and third class, is thus far beyond the reach of therapeutics.

OPTICAL THERAPEUTICS; NORMAL AND ABNORMAL REFRACTION; PRESBYOPIA; PRINCIPLES INVOLVED IN FITTING GLASSES.

By EDWARD JACKSON, A. M., M. D.

The importance of optical therapeutics and the extent of the indications for its employment are as yet imperfectly appreciated. The *raison d'être* of the eyeball and its appendages is simply to support the retina in a position where it shall receive light that is accurately focused. This focusing or assorting of rays is accomplished by the action of the dioptric media, and depends entirely on the perfection of their adjustment. That dioptric adjustment of the eye which secures with the minimum of exertion the perfect assortment or focusing of the light falling on the retina might be called the *normal refraction* of the eye, and all adjustments that do not secure this *abnormal refraction*.[1] In the former case, however, the word "normal" would have a significance quite different from that which it usually possesses. It would not refer to the usual condition of the mass of eyes in health, but rather to an ideal condition that is really non-existent, and only rarely is very closely approximated.

A more practical definition of normal and abnormal refraction is that which classifies as *normal* the refraction of those eyes which sufficiently approximate the standard of perfect refraction to enable their possessors to perform all acts of vision that they find necessary or desirable, without pain, inconvenience, or detriment either to the eye or to other portions of the body, and classifies as *abnormal* the refraction of all eyes which by reason of their departure from such standard fail to furnish their possessors with the required visual power on such terms of health and comfort. But in adopting this practical conception of normal and abnormal refraction it must be clearly understood that the class to which the refraction of any given eye belongs is not to be determined simply by the amount of its deviation from the perfect standard.

[1] *The Anomalies of Accommodation and Refraction of the Eye*, by F. C. Donders, published by the New Sydenham Society in 1864, remains the most important work on this subject for the thorough student. Next to it comes the *Refraction and Accommodation of the Eye*, by E. Landolt, translated by C. M. Culver.

This amount of the deviation—the *error of refraction* or *anomaly of refraction*, as it is called—has often much less to do with determining this point than the occupation, general health, or idiosyncrasies of the individual. Precisely the same state of refraction may be strictly normal in the farmer and very abnormal in the seamstress; and without any change whatever in the degree of error present the refraction may pass from normal to abnormal with a lowering of the general nervous tone, and from abnormal back to normal with a restoration to health. Adopting for it this comprehensive and extremely elastic definition, we may say that *abnormal refraction is the indication for a resort to optical therapeutics.*

The process of assorting or focusing the light that falls on the retina is effected entirely by the physical properties of the dioptric apparatus of the eye. But the physical properties of this dioptric apparatus are capable of a certain amount of alteration or adjustment by certain vital acts. Thus the curvature of the crystalline lens can be increased, and hence its action as a lens in focusing the light passing through it altered by the vital acts causing contraction of the ciliary muscle. Then, too, the impressions made upon the retina become the basis of extensive and complicated actions on the part of great nerve-tracts—actions that are powerfully influenced by the perfection or imperfection of those impressions as determined by the focusing of the light that makes them.

Thus, abnormal refraction becomes the indication for optical therapeutics, either for the *imperfect vision* itself, manifested simply by the patient's inability to see that which he should have the power of seeing clearly, or for the more remote consequences of imperfect vision and the symptoms resulting from the effort to overcome it, which may be grouped under the general head of *eye-strain.*

Imperfect Vision.—This defect, of which the patient may or may not be conscious, may be discovered by either of many tests. The most valuable are the tests with special series of block letters, either on the original Snellen scale or one of its many modifications. The essential advantage of such test letters is that their size is accurately graded to the distance at which they are designed to be seen. The letters to be seen at twenty feet are twice the size of those to be seen at ten feet; the two-hundred-feet letters ten times the size of the twenty-feet letters; and so throughout the series.

With such a series it is easy to get an expression of the acuteness of vision by a fraction, the distance at which the letters are seen being taken for the numerator, and the distance at which the letters should be visible to a normal eye being taken as the denominator. Thus, if the twelve-metre (forty-feet) letters are the smallest that can be made out at six metres (twenty feet), the visual acuteness is said to be six-twelfths. When the letters are visible at the full distance at which

they should be seen by the normal eye, the fraction becomes six-sixths, equal to one, so that the unit is the expression for normal acuteness of vision. It should be borne in mind, however, that the usual standard of full or perfect sight is not sufficiently high;[1] something better should be habitually aimed at in endeavoring to attain the best possible vision with the aid of glasses. To be satisfied with the usual standard is in many cases to fail to give the patient the full benefit of optical therapeutics.

With imperfect focusing of light on the retina, separate points, to be recognized as separate points, must have their impressions fall farther apart, and therefore the points themselves must be more widely separated. In other words, the object must be larger, or, what amounts to the same thing, it must be brought nearer to the eye, where it will make its impression on a larger part of the retina. That is, the imperfection of focusing lowers the acuteness of vision, and is by far the most frequent cause of inability to attain the normal standard.

Eye-Strain.—Under the head of Asthenopia this subject is elsewhere referred to, but it is necessary to consider here certain phases of it. It is commonly recognized as dependent on the requirement of excessive effort on the part of either the ciliary muscle to accommodate or focus the eye properly, or of the external muscles of the eyeball to keep the visual axes properly directed. It is, however, likely that its phenomena are sometimes in part due to the effort to recognize mentally the significance of defective retinal images, quite aside from any effort to make these images more perfect.

Even in strain of accommodation and convergence the effect is by no means so simple as the mere over-tiring of one or more muscles. It may lie wholly in the overcoming of difficulties of co-ordinating the different nervous impulses required for the carrying on of the act of vision. The inconvenience experienced when the patient commences the wearing of correcting glasses is essentially of this nature.

It is generally appreciated that the over-use of an organ may lead to pain and hyperæmia of the organ itself and of contiguous parts. The ciliary muscle, lying directly in the uveal or vascular coat of the eye, and exerting a direct mechanical influence on the other constituents of that coat, can scarcely suffer without the nutrition of the choroid and of the parts that depend on the choroid for their nutritive supply, the retina, the vitreous, aqueous, and lens, also becoming impaired. The intimate connection of its vessels with those that supply the sclerocorneal coat will also explain the liability to involvement of the latter. And one who has seen the puffiness of the lids that marks the onset of

[1] Jackson, "Tests for Visual Acuteness," *Journal of the American Medical Association*, Jan. 31, 1891; Dennett, "Test Type," *Trans. American Ophthalmological Society*, 1885, p. 133.

some intraocular inflammations will not be inclined to doubt a connection that would render quite possible serious inflammations of the lids from strain of the ciliary muscle.

The effects of eye-strain shown by the retina are comprised under the headings of hyperæmia and opacity.

Although these retinal conditions may arise from quite other causes, eye-strain is that from which they most commonly spring. They are, perhaps more than other effects of eye-strain, closely connected with the amount of eye-work done, the general condition of the nervous system, and with deficiencies of blood-supply, rather than with any especial form of abnormal refraction. And to that extent they are an indication for lessened work and general remedial measures. But in a very large proportion of cases the accurate correction of the ametropia is essential for their relief.

The *choroidal changes* due to eye-strain are more frequently seen, and mostly originate in eyes affected with hyperopia and astigmatism, these being the more frequent errors of refraction, although it is with myopia and close eye-work that a vicious circle is established that secures their most complete and disastrous development.

The most characteristic and advanced changes are generally exhibited by the portion of the choroid immediately adjoining the optic disc, particularly on the temporal side. Here is found an area of choroiditis and atrophy usually crescentic in form, but which tends to extend around the disk and ultimately to encircle it, at the same time broadening out toward the region of the macula. Exceptionally, the crescent lies below or above or on the nasal side of the nerve-entrance. Very extensive or advanced changes in the region of the disc are apt to be accompanied by important changes in other parts of the choroid, particularly in the region of the macula, where they sufficiently involve the nutrition of the retina greatly to impair the acuteness of vision.

Although the choroidal changes are commonly noted as confined to certain regions, they are often, in their earlier and more acute stages, more general. But it happens that when the causative temporary stress is taken off, the larger part of the choroid recovers more or less completely, and only in certain portions does the process go on to cause notable permanent lesions. In the acute cases the whole choroid presents a "patchy," "woolly," abnormally scarlet, or "flannel-red" appearance, indicative of hyperæmia and œdematous swelling. And such an appearance is an indication for rest of the eyes in addition to their optical correction.

The effects of eye-strain on the *optic nerve-entrance* or *optic disk* resemble those produced on the retina in that they are manifest clinically as hyperæmia and opacity. A certain amount of such reddening is physiological and attends any considerable use of the eyes. But this

normal hyperæmia quickly passes away with the suspension of eye-work. If, on the contrary, hyperæmia persists or appears on a very slight use of the eyes, it becomes an indication for optical therapeutics. Opacity on the disc involves the mass of normally transparent nerve-fibres and delicate connective tissue that constitutes the head of the nerve. It veils or entirely conceals the deeper structure of the nerve, and, being associated with the similar condition of the retina, obscures the margins of the disk, most at the upper and lower borders, least to the temporal side. The ophthalmoscopic picture is precisely that of a slight optic neuritis, which is really the condition present, the lower grades of such inflammation being more frequently due to eye-strain than to all other causes taken together.

The *vitreous* suffers from eye-strain through the involvement of the choroid and by reason of the abnormal increase of the space it is required to fill by the increase of the globe in myopia, in connection with which vitreous opacities and disorganization, not due to traumatism, usually occur.

That the *crystalline lens* should suffer from the effects of eye-strain seems quite probable when we remember that the strain is largely through the over-use of the ciliary muscle, the function of which is to act upon the shape of the lens, and that the lens depends for its supply of nutritive material upon the uveal tract, which is profoundly affected by eye-strain. The diseases of the lens, however, lead to opacity, and have heretofore been grouped under the head of cataract. And in their extremely chronic course but little careful study of their etiology and progress has heretofore been attempted in the earlier stages. But it is likely that in a considerable class of cases cataract is in large measure due to eye-strain, and to a similar extent preventable by the proper use of lenses.[1]

The *cornea* is not particularly liable to suffer from eye-strain, yet it may show inflammation secondary to inflammation of the conjunctiva; and in some instances, where the corneal disease was the most serious feature of the case, it has failed to yield to the remedies employed until the proper correcting glasses have been worn, after which improvement was rapid. Such cases present no especial characteristics. But it is well to bear in mind this application of optical therapeutics in dealing with any chronic case of inflammation of the cornea.

Inflammation of the *conjunctiva* due to eye-strain is extremely common. In its clinical features it is in the main identical with inflammations from general irritants or "cold." What is characteristic is its persistence or repeated recurrence or its aggravation by use of the eyes. Persistent inflammation points always toward a persistent cause, and by far the most frequent persistent cause is some error of refrac-

[1] Risley, *Ophthalmic Review*, 1891, p. 225.

tion. It is not to be denied that there very often coexists another important factor in some tendency of the mucous membranes in general to inflame under slight provocation. But even when this is present the efficient therapy will often be optical, for we understand the correction of errors of refraction very much better than the eradication of the scrofulous and other diathetic taints.

Inflammation of the other tissues of the lids is very apt to arise from chronic inflammation of the conjunctiva, and is thus dependent ultimately on the same cause. The form commonly due to eye-strain is that in which the free margins of the lids become thickened and rounded and the lashes diseased and deformed. Repeated styes, minute abscesses centring about hair-follicles, which might be regarded as a more acute form of the same trouble, may also be due to abnormal refraction.

More General Symptoms of Eye-Strain.—*Headache*, the most common and the most important of the general symptoms of eye-strain,[1] may vary in intensity from that which "is not an ache," but only a slight feeling of fulness or discomfort, to the most agonizing hemicrania or sick headache. In the main, eye-headaches are like other headaches. They rarely, however, seem to centre in the vertex. Usually they are most severe or are felt only in the frontal region, "through the temples" and "just back of the eyes." But very often some pain is referred to the occipital region, and occasionally they are felt there only. Often the patient observes that they are aggravated or brought on by some especial eye-work, but in other cases, where the relief afforded by glasses is just as great, no such connection is noticed. In many cases they are felt after travelling, shopping, attending church or the theatre, or doing other things that are not thought of as being especially trying for the eyes, though in reality very likely to develop eye-strain. They are liable to be brought on or aggravated by hunger or general exhaustion, are liable to be aggravated by indigestion or constipation, and are not rarely associated with nausea and vomiting.

Let this be clearly understood, that eye-headaches are not a special and peculiar variety of headaches, but that eye-strain enters as a factor into the causation of those common headaches which the profession has always had to combat, and which have been ascribed to many causes and many organs, but most of all to the point of popular therapeutic attack, the stomach; and that in this age, when a large proportion of our patients verge upon neurasthenia and the eye is taxed as never before, this factor of eye-strain is in a very large proportion of cases the most important one. At all events, it is one about which we have a definite understanding, one that we can investigate and remove. And

[1] S. Weir Mitchell, *Amer. Journal of the Medical Sciences*, April, 1876, p. 363.

no case of headache has had the benefit of modern therapeutics that has not had this factor investigated and excluded or removed.

Pain in the eyeball itself may be but a certain form of headache, or it may be due to the intraocular hyperæmia following excessive eye-work. A feeling of tension or "drawing" within the orbit or "just between the eyes" may be a true soreness of the orbital muscles.

Pain, commonly neuralgic in character, located in other parts of the body, especially in the maxillary divisions of the trifacial and in the back, is sometimes permanently relieved by the removal of eye-strain.

Other forms of disordered nerve-action due to eye-strain are manifested by attacks of numbness or of formication, which may be quite local or may affect the whole of one side. Closely allied to these is the visual disturbance known as *ophthalmic megrim*. Either is to be regarded as possibly due to eye-strain.

Eye-strain can, and not very rarely does, cause habitual anorexia, and even nausea and vomiting, dyspepsia, palpitation of the heart, and other visceral neurotic manifestations.[1] And in these more irregular manifestations the therapeutic test may be required to establish the diagnosis.

There can be little doubt that this kind of nerve-strain may, like other varieties of nerve-strain, prove an exciting cause of insanity or combine with other causes to develop such abnormal cerebral action.

That peevishness, undue irritability, and other psychic evidences of nerve-exhaustion arise from eye-strain quite independently of any headache or other form of conscious pain is frequently illustrated; and eye-strain is often a most important factor in the development of hysteria.

Of the *motor disturbances* due to eye-strain, the most common are those of the muscles immediately accessory to the eye. Those of the orbital muscles are considered at length under the headings of Squint and Muscular Insufficiencies, or Heterophoria, Nystagmus, etc. Next to them come the irregular actions of the orbicular muscle of the lids, the corrugator of the brows, and the frontalis. These are usually over-actions, and may aid in making vision less indistinct, as the nipping together of the lids that gave the name to myopia, or they may be simply due to the overflow of nervous impulses through neighboring nerve-channels that attend excessive exertion, as the contraction of the brows that often comes on with eye-work. Or they may be distinctly pathological reflexes, as twitching of the lids or the more prolonged spasm to which the name blepharospasm is commonly applied. But more distant muscles may be effected; thus spastic wry neck and contractures of more distant muscles have been relieved by optical thera-

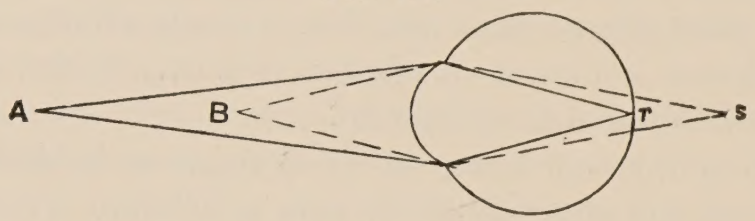
[1] G. M. Gould, *Medical News*, Aug. 23, 1890.

peutics. There can be no question that in rare cases eye-strain gives rise to well-marked choreic movements and epileptiform seizures;[1] and in cases of obscure etiology the small chance of relief that optical therapeutics affords should not be neglected.

Normal Refraction, Emmetropia, Accommodation.

When the refraction is normal, as we have defined it, the rays of light coming from one point outside of the eye are all focused or brought to a single point on the retina. Thus in Fig. 145 the rays coming from the point A are focused on the retina at the point *r*, and the same thing

Fig. 145.



occurs for every other point situated at the same distance from the eye, so that each point of the object looked at makes its impression on a single point of the retina, and each point of the retina receives the impression of but a single point of the object looked at. In this way each part of an external object is made to send its separate message to the brain, and we are able by sight to distinguish the various objects presented to us. But this is true only of objects situated at a certain distance for which the eye is adjusted. If the object be situated nearer to the eye, as at B, the rays from it will not be focused upon the retina, but would tend to a focus back of the retina at *s*, and at the retina will be so spread out as to interfere with the rays coming from other points, and imperfect vision will result. In order to get perfect vision at the distance of B, it would be necessary to increase the refractive power of the eye, so that it could bend the more divergent rays from B enough to bring them to a focus at *r* on the retina. To see clearly at various distances it is necessary that the eye shall have some power of adjustment; and such a power is possessed by all normal eyes up to a certain age: it is called the power of *accommodation*.

Parallel Rays.—The rays of light that come off from any luminous point diverge in all directions, and they continue to diverge always unless they encounter something that acts on them, as a convex lens or a concave mirror. When, however, the rays come from a point more than fifteen or twenty feet from the eye, they are so nearly parallel that they may be regarded as parallel without serious inaccuracy.

The *refraction* of an eye, as the term is used technically, is its

[1] G. E. de Schweinitz, *New York Medical Journal*, June 23, 1888.

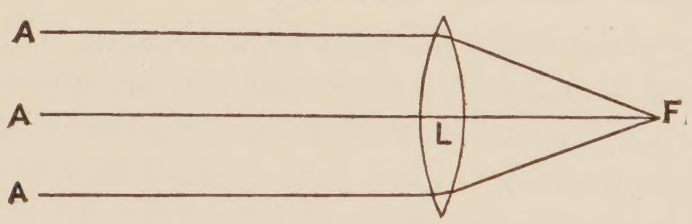
power of focusing rays on its retina when it is entirely at rest, when none of the power of accommodation is exerted. An eye that can in this state focus parallel rays on its retina is said to be *emmetropic;* that is, properly proportioned. Its state of refraction is called emmetropia. Such an eye sees distant objects distinctly without any exertion of its accommodation and without any possibility of strain. For near vision, however, it is compelled to use its accomodation in order to obtain perfectly focused images, and when this accomodative power is insufficient eye-strain results.

Presbyopia, Old Sight.—The change which comes with age to all normal eyes is the diminution of the accommodation. When this diminution of accommodation has gone so far that the rays from near objects can no longer be focused on the retina without undue exertion of the ciliary muscle, we may say that *presbyopia* has set in.

The effect of the accommodation is equivalent to the placing of a convex lens before the eyes, and it is customary to designate the amount or amplitude of accommodation by the amount of lens strength it adds to the refracting power of the eye.

The action of a convex lens on light, the same as that of the convex surfaces of the cornea and lens in the eye, is illustrated by Fig. 146 in

FIG. 146.



which the parallel rays AAA are brought by the lens L to a focus at F. The stronger the lens is, the more it turns the rays from their original course, the more quickly are they brought to a focus, and of course the nearer the focus is to the lens. In Fig. 146 the rays AAA are represented as parallel, and the focus F for parallel rays is called the principal focus of the lens. The distance of the principal focus from the lens is called its focal distance. The strength of the lens, being inversely as the focal distance, is expressed by 1 divided by the focal distance.

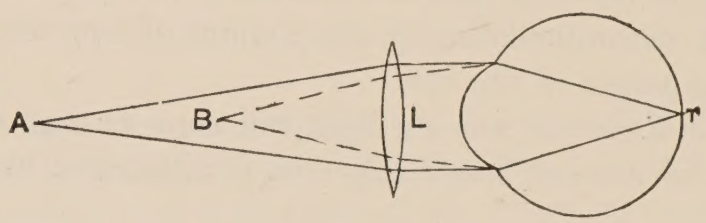
There are two systems of numbering lenses—the inch system and the metric or dioptric system. In the inch system the strength of a lens is indicated by 1 divided by the focal distance in inches. In the metric system[1] the strength of the lens is expressed by 1 divided by the focal distance in metres. The lens with a focal distance of 1 metre, being the unit, is called a 1 dioptric lens. On account of the ease with which the strength of the lenses thus expressed can be com-

[1] Landolt, *Royal London Ophthalmic Hospital Reports*, vol. viii. p. 632.

bined by addition and subtraction, and for other reasons, the metric system is supplanting the older inch system. It will be used exclusively throughout this article.

If in Fig. 146 the luminous point from which the rays pass off be placed at F, the lens will so change the course of those rays that pass through it as to make them parallel. Now, in the case of an emmetropic eye that has become presbyopic—that is, any eye that has no fault with its focus except that it has lost its accommodation through age, even if the loss of accommodation be complete—it is only needful to take a convex lens that has its principal focus at the point looked at, and which will therefore make the rays passing through it parallel, to have them focused on the retina and the object distinctly seen. For the eye without any effort of the accommodation is fitted to focusing parallel rays. Thus in Fig. 147 rays coming from the point A to the

FIG. 147.



convex lens L, which has A L for its focal distance, will fall upon the eye parallel, and be focused on the retina without any exertion of the accommodation. If, however, there be some power of accommodation present, it will be possible to focus rays on the retina from a still nearer point, as B, or from any point between A and B.

In a case of presbyopia, then, if the accommodation be entirely gone, we must use the convex lens that will have its principal focus at the point looked at, which will have a focal distance equal to the distance of that point from the position of the lens before the eye. When some power of accommodation still remains, a weaker lens is to be used, and the remaining accommodation allowed to complete the focusing of the rays. The fixing of how much shall be done by the glass and how much left to the accommodation is the field for art in the optical therapeutics of presbyopia.

If a person having some power of accommodation brings the object he is looking at closer and closer to his eyes, he finds that he can see it clearly only with increasing effort, until presently a point is reached nearer than which no amount of effort will enable him to see clearly; this is called the *near point* of distinct vision. At that point to see clearly he must exert all his power of accommodation. The distance of that point from the eye, then, is the focal distance of the lens that would represent his total power of accommodation. Thus if the point

is one-third of a metre (thirteen inches) from his eye, he has 3 D. of accomodation.

But this maximum of exertion of which the ciliary muscle is capable could not be continuously sustained for reading or sewing or other near work. The part of the focusing that can be left for the accommodation to do must therefore be considerably less than the total amount of the accommodation. It is found that young persons—say under thirty years—cannot use habitually more than half of their total accommodation without suffering from eye-strain. But those who are older, and whose accommodation is on that account considerably diminished, can use two-thirds of what remains without inconvenience. These proportions are only average or usual proportions, and any individual case might vary widely from them. But in selecting the lens for a presbyopic eye we would, in the absence of other indications, be guided by the rule to allow the patient to use two-thirds of his remaining accommodation for near work.

The time of life at which presbyopia will occur is determined by the progress of the failure of accommodation and the nearness of the point at which it is required to see clearly. The watchmaker or engraver, having to bring his work very close to the eye to see the fine details, will have to use a convex lens before he is twenty. The laborer who does not have to see distinctly any closer than arm's length may go to over fifty without noticing inconvenience. For the mass of people, however, the principal use of the eyes for near work is in reading, writing, and sewing, which are done at a distance of from twelve to eighteen inches from the eyes.

The accompanying table[1] shows about the average diminution of accommodation for each five years from forty to sixty in 1000 cases noted in the writer's practice, the first column giving the age, the second column the amplitude of accommodation at these respective ages, the third column the two-thirds of the accommodation that is available for habitual work, and the fourth column the lens that would be required to supplement this accommodation to allow of continuous near work at the distance of one-third of a metre (thirteen inches), supposing the eye to be emmetropic.

Age.	Dioptres Accommodation.	Dioptres Available.	Dioptres Lens.
40	5.	3.6	
45	3.3	2.2	1.
50	2.	1.3	2.
55	0.5	0.3	2.75
60	0.	0.	3.

[1] This table differs somewhat from those of Donders, *Accommodation and Refraction of the Eye*, pp. 207 and 220, and Landolt, *Accom. and Ref. of the Eye*, English translation, p. 178.

It should be clearly borne in mind that such a table is not to be used as a basis for the prescription of glasses in any individual case.

The proper way to determine the strength of lens to be used in a given case of simple presbyopia is to find the near point of perfect focusing. The distance of this point from the eye will be the focal distance of the lens equal to the accommodation. Two-thirds of that lens' strength is the most the patient must use for his near work. Now ascertain the nearest point at which the patient must hold his work. Its distance from the eye will be the focal distance of the lens power required for his work. Subtract from that lens power the required two-thirds of his accommodation that he can use, aud the remainder will be the lens power that must be made up by the glass, the strength of the lens correcting his presbyopia.

To illustrate by an example: Suppose the near point is at one-third of a metre, the accommodation then amounts to 3 D., and two-thirds of that, or 2 D., is what can be used without eye-strain. If glasses are required for reading at the distance of twelve inches, the focal distance of the 3.25 D. lens, the focusing power required is 3.25 D. From this total of 3.25 required subtract 2 D., the amount of accommodation that can be used, and the remainder, 1.25 D., is the strength of the lens that must be given to assist his accommodation and correct the presbyopia.

As in different persons the accommodation fails with different degrees of rapidity, so it may in the different eyes of the same individual. In which case one eye may require a stronger lens to correct its presbyopia than the other; and in rare instances it is necessary to order lenses with such difference. But this should not be done without repeated measurements of the power of accommodation to make sure that it is neither an error of observation, a neglect on the part of the patient to make the same effort when one eye is tested as he did for the other, nor a merely temporary condition.

Since presbyopia is due to failure of the power of accommodating the eye for near objects, it is manifest by imperfect vision or strain when near objects are looked at, and the first indications of it are given when the attempt is made to look at the smallest objects or by the poorest light—conditions that necessitate the bringing of the object looked at nearer to the eye; for instance, the reading of fine print by artificial light. At first this is still possible, but only with undue effort. And sometimes this effort can be kept up and the print seen clearly for a while, until the endurance of the ciliary muscle is exhausted and it suddenly relaxes, and the print blurs or "runs together" and reading has to be discontinued. Sometimes an instant's rest allows the ciliary muscle to recover somewhat, and reading can be again resumed. But after a somewhat shorter time the blurring again occurs, and if the effort be

persisted in the intervals of clear vision become shorter and shorter until the attempt has to be given up. This temporary blurring of near vision is most apt to occur when the general physical condition of the individual is below par, as toward the latter part of the day or in the evening when wearied by the day's exertion.

In other cases instead of this actual failure of vision we have the ability to see clearly even for long periods, but only at the cost of eye-strain. Persons who have been putting off wearing glasses as long as possible are very apt to complain of irritation or inflammation of the conjunctiva. Every "cold" they catch "settles there;" that is, they have repeated attacks of acute conjunctivitis. Or they are troubled with smarting and burning of the lids, sometimes constant, sometimes clearly connected with the use of the eyes for near work. The other symptoms of eye-strain may constitute the indication for glasses in presbyopia, but those above mentioned are the most frequent. Sometimes the only thing complained of is that objects to be seen clearly have to be held at an inconveniently great distance.

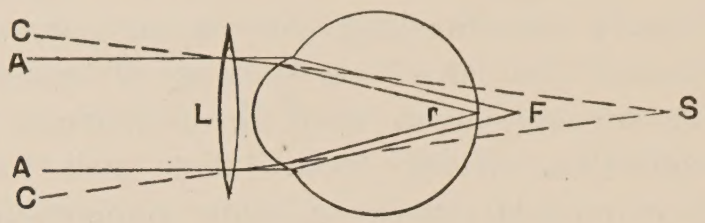
Need for changing the glasses from time to time arises in all cases of presbyopia from the progressive loss of the accommodation. This need will be indicated by the same symptoms as mark the advent of presbyopia, and it arises from time to time until there is no accommodation left, after which the patient may not require any change of glasses for many years. The frequency of these changes varies somewhat with the sensitiveness of the patient to slight inconvenience or with the extent and accuracy of the near seeing required. But in general they should be made as often as once in every two years. Each time such a change is made the lens is to be chosen in the manner already described for commencing presbyopia. The difference between the successive lenses will vary with the interval that elapses and the rapidity with which the accommodation is lost.

Hyperopia, Hypermetropia, Far-sight, or **Over-sight,** also requires convex lenses for its correction. It is the condition in which the eyeball is too short or its refraction is not strong enough, so that when the eye is at rest, the accommodation in abeyance, the rays reach the retina before they have been brought to a focus, even if they have entered the cornea parallel, are still farther from being focused on the retina if they have fallen upon the eye divergent, and are only accurately focused on the retina if they reach the eye to a certain extent convergent or by the exertion of the power of accommodation to supplement the deficient refraction.

This state of the eye is illustrated by Fig. 148, in which the parallel rays A A are represented as entering the eye and being converged to the focus F back of the retina, not having been bent sufficiently from their original course to be focused at *r*. In order that rays shall be focused

at *r* with the eye in this state, it is necessary that they should fall upon the eye in the direction of C S. To cause the parallel rays to be focused at *r* it is necessary to place before the eye a convex lens just strong enough to have its principal focus, the focus for parallel rays, at S, the

FIG. 148.



point toward which C and C converge. The rays falling on the lens parallel will then be converged in the direction C S C S, and the eye will be able to focus them at *r*. If such an eye, however, possesses enough accommodation, this accommodation can take the place of the convex lens and cause parallel rays to be focused on the retina and distant objects to be clearly seen. And if, after doing this, there remains enough additional accommodation, by its use the rays from near objects also can be perfectly focused. But it is evident that the amount of accommodation available for near vision will be diminished below that which could have been used for this purpose if the eye had been emmetropic by so much of it as was required to focus parallel rays on the retina.

The hyperopic eye therefore is at these disadvantages as compared with the emmetropic eye: First, it has not as much accommodation left for near seeing, and therefore cannot see objects as near to the eye; second, whatever the distance of the object, more accommodation is required to see it clearly; third, that as some accommodation has to be used for distant vision so long as distinctness of vision is maintained, the hyperopic eye can have none of those periods of complete relaxation of accommodation that come to the emmetropic eye when gazing on distant objects; fourth, after the accommodation has been lost vision is indistinct at all distances.

These disadvantages lessen the amount of work that it is capable of doing without inconvenience or injury, particularly in the direction of prolonged near work. But by wearing constantly before the eye a convex lens like L (Fig. 148), that just corrects the hyperopia, they are all removed. The accommodation is all rendered available for near seeing; no excessive exertion of it is required; in seeing at a distance the accommodation is at rest; and distant vision is clear after the accommodation is lost. In hyperopia, therefore, the indication is most fully met by the constant wearing of the correcting lens. But there are cases in which the symptoms are closely connected with some special use of

the eyes, as for reading, and where at other times the error of refraction causes no trouble. In such cases it is proper to have the glasses worn only when the eyes are used for that especial purpose, since the thing we are called upon to do in practice is not to correct mathematical inaccuracies in the proportions of the eye, but to give relief from their unpleasant consequences when such are produced.

In early life the accommodation is usually more than sufficient to correct the hyperopia and enable the patient to see clearly at a distance; hence the eye is said to be *far-sighted.* But even in childhood, if the fault be great, near seeing may be interfered with. This interference usually takes the form described in connection with presbyopia, in which clear vision can be obtained, but only for a brief period, after which a sudden blurring or confusion of the image occurs. After most of the accommodation has been lost it becomes impossible to see even distant objects clearly, and without the aid of glasses vision is imperfect at all distances.

Most ophthalmologists are agreed that it is always proper to correct the manifest hyperopia. Donders advised the correction of all the manifest and one-fourth of the latent hyperopia. The practice of the writer is to *correct the total hyperopia.* To this rule some exceptions may be made, but rarely and only for some clear and definite indication. It may also sometimes be necessary to give a partial correction for a few weeks or months, because the patient will not submit to the interference with distant vision from unrelaxed spasm of accommodation. But the great majority of patients, if properly warned of the trouble beforehand, will cheerfully undergo this inconvenience, and in the end prefer it to a change of glasses. By use of the full correction of the total hyperopia the period of adaptation is not lengthened, but shortened. In giving the full correction, however, care must be taken not to fall into the error of giving an over-correction, since any excess of the strength of the convex lens will to that extent permanently interfere with distant vision, and even the slightest interference with it is unsatisfactory to those who have previously enjoyed perfect distant vision. A common mistake is to order for distant vision the lens that gives perfect vision at fifteen or twenty feet, and which is always a sixth or quarter dioptre too strong for very long distances. Even so slight an inaccuracy will render the glasses quite unsatisfactory.

Indications for Correcting Hyperopia.—The symptoms that lead the hyperope to seek relief are apt to vary with the time of life at which they are manifest. One of the earliest is *convergent squint,* which is liable to occur at the age at which the child begins to fix its eyes accurately and steadily on near objects. The connection between hyperopia and strabismus is discussed in connection with the latter

condition. It is most satisfactorily established for the intermittent squints that are associated with high degrees of hyperopia, and cases of that class are almost invariably relieved by the wearing of the proper convex lenses. In many other cases the connection is less certain, but in most cases of squint it is worth while to give a trial to the wearing of glasses before resorting to operative treatment. For the relief of squint the lenses must correct the total hyperopia, and should be worn constantly.

From the earliest age at which children are able to give an intelligent account of their feelings hyperopia is a most prolific source of *headache*. Many do not know what it is to be free from it during their school-sessions, although they do not connect it with the use of the eyes. In most cases it is needful to resort to lenses correcting the total hyperopia, which should be worn constantly, at least for a time. If the hyperopia be of moderate or low degree, it will often be practicable after a few months to allow the discontinuance of the glasses except for near work, or, if the amount of near work done be small, to lay them aside altogether. But this should be mentioned only as a possibility or probability, never promised as a certainty, and should not be tried until complete relief has been afforded for a considerable time. For a large part of the community school-work is about the severest test the eyes have to undergo up to middle life, so that they may well require more aid at this time than for years afterward. Still, headache is liable to arise from hyperopia, and to require the same treatment, at any time of life up to the age at which the power of accommodation is lost.

Inflammatory troubles due to eye-strain may also occur at any age up to that of the loss of accommodation. In childhood they are more apt to involve the lids as styes or marginal blepharitis, and require the constant use of the correcting lenses, with sometimes additional local and constitutional treatment. Later in life they are more apt to take the form of conjunctivitis, which sometimes, not always, can be relieved by using the glasses for near work only.

The *retinal* and *choroidal* changes of eye-strain are most common among school-children who have hyperopia with or without astigmatism. They call for the constant use of the glasses, often with a complete cessation of eye-work under the compulsion of a mydriatic; but after the ocular health has been restored it may, under more favorable circumstances, be maintained without such constant need of lenses.

Impairment of vision may arise in hyperopia from choroido-retinal changes, in which case it affects the seeing at all distances, but it is more noticed for distant objects. Or it may arise from excessive spasm of the ciliary muscle, causing a simulated myopia, in which case it is distant vision alone that is affected. More characteristic of

hyperopia is failure of near vision—a sort of presbyopia occurring at an earlier age than presbyopia usually appears in emmetropic eyes, but manifesting any of the symptoms of presbyopia.

As the power of accommodation sinks with age, there comes a time to every hyperopic eye, however, when distinct vision is impossible at any distance without the aid of lenses, and even distant objects are somewhat blurred. Of course the higher the degree of hyperopia the earlier this condition is reached. In the highest degree it exists from early childhood. In low degrees it may appear about the age of fifty or a little over. Whenever it does begin, lenses will be necessary for distinct vision from that time forward to the close of life. In aphakia, either congenital or produced by the removal of the crystalline lens, the hyperopia is usually high, and of course entirely absolute.

Changes in the degree of hyperopia when they occur will necessitate corresponding changes in the strength of the lenses used for its correction. But these changes are rather those which may occur than such as are likely to occur in any given case. And at any period of life the hyperope may be able to wear his correcting glasses for many years without needing any change in them.

Hyperopia with Presbyopia.—In hyperopes, though they may have escaped earlier trouble from their optical defect, presbyopia comes sooner than it does to emmetropes.

So long as the power of accommodation remains sufficient to fit an emmetropic eye for its near work, it is only needful to correct the hyperopia with its appropriate convex lens. When, however, the power of accommodation falls so low that convex lenses would be indicated for presbyopia, even though the eyes were emmetropic, it becomes needful to give for near work a convex lens correspondingly stronger than the one required for the correction of the hyperopia. The additional strength required may be ascertained by placing the lens correcting the hyperopia before the eye, testing the near point of distinct vision so obtained, and from it calculating the lens required for the presbyopia, and adding its strength to that of the hyperopic correction; or it may be directly calculated by determining the total amount of accommodation from the position of the far point and the near point, and deducting two-thirds of it from the total accommodative or lens effect required to correct the hyperopia and adjust the eye for the working point.

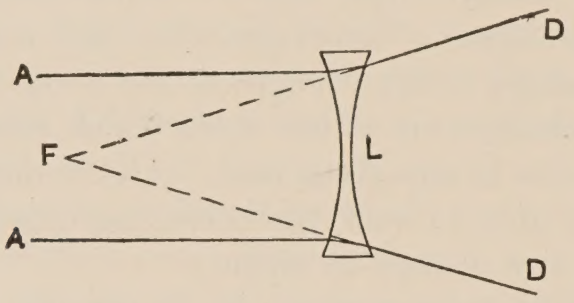
If the hyperope who has become presbyopic must secure distinct distant vision by wearing the lenses correcting his hyperopia, he will find it necessary to employ stronger lenses for his near vision; that is, he must have two pairs of glasses. Many hyperopes do not have to wear any correction for distant vision, and others may use it only at particular times when clear distant vision is especially desirable or

there is especial danger of straining in the effort to see clearly at a distance; but in all cases it will be needful to use the glasses correcting both hyperopia and presbyopia for near work.

Concave Lenses and Myopia.

Myopia, Short-Sight, or **Near-Sight,** requires for its correction the use of concave lenses. A concave lens is one which is thinnest at the centre and thickest at the margin. Its action on pencils of light-rays passing through it is to make the rays more divergent or less convergent. This action is illustrated by Fig. 149, in which L represents a concave lens on which fall parallel rays A A, which are caused

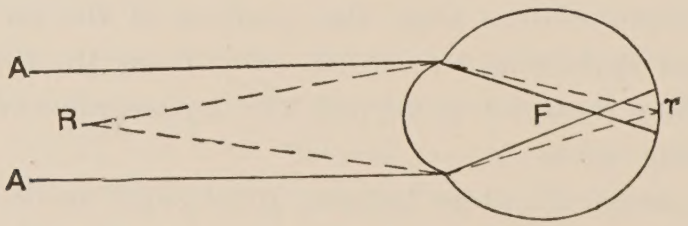
Fig. 149.



to diverge toward D D as though they had originally come from the point F, which is the principal focus of the lens. Of course the stronger the lens the more the rays are turned from their original course by it, and the nearer to the lens will be its focus; so that, just as in the case of convex lenses, the strength of the lens will be indicated by one divided by the focal distance, and what has been said of the numbering of convex lenses is equally true of concave lenses.

The *myopic eye* is one in which the antero-posterior axis is too long or the refractive power of the cornea and crystalline lens is relatively too great, so that parallel rays entering the eye are brought to a focus before they reach the retina, and by the time they reach that membrane are spread out again, and the impression they make on the retina is

Fig. 150.



a blurred, indistinct one. In order that the rays shall be perfectly focused on the retina of such an eye it is necessary that they should have a certain divergence when they strike the cornea, as when they come from a certain point near the eye. This is illustrated in Fig.

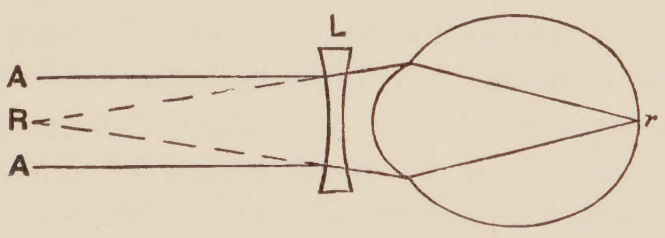
150, in which the parallel rays A A are brought to a focus F in front of the retina, while rays from the point R are brought to a focus at *r* on the retina.

In order that parallel rays or those coming from distant objects shall be focused on the retina, they must be given the necessary degree of divergence by placing before the eye the required concave lens.

The point R from which rays are focused on the retina when the eye is at rest—that is, when it is using no power of accommodation—is the *far point* of distinct vision for that eye. If rays reach the eye from any point beyond it, they must be less divergent than the rays coming from that point, and therefore will be focused in front of the retina unless their divergence is increased by passing through a concave lens. On the other hand, if the power of accommodation is exerted, it brings the focus farther forward, increasing the blurring of distant objects and enabling the eye to focus on the retina the rays of nearer objects.

The strength of the concave lens required to bring the focus for parallel rays upon the retina when the eye is at rest is such that when the lens is placed before the eye its principal focus shall be at the far point of the eye, because a concave lens turns parallel rays so that they diverge as though they had come from its principal focus. Thus in Fig. 151 the lens L that will cause the parallel rays to be focused at *r*

FIG. 151.



on the retina is the one which has its principal focus at R, and turns the rays that enter the eye as though they had originally come from R, the point for which the eye is optically adjusted. Such a lens is said to "correct" the myopia, and the amount of the myopia is designated by its strength.

It will be noted that the closer the lens L (Fig. 151) is placed to the point R, the stronger must it be to make the rays diverge from that point; and the closer it is placed to the eye the weaker it must be to accomplish the same purpose. Hence the nearer the lens is placed to the eye the weaker the lens required to correct a given case of myopia. This point has an important bearing on the selection of the proper correction by the use of trial lenses and on the mounting of the lenses that are to be worn.

The effect of placing before it the correcting lens is in the main to

reproduce for the myopic eye the optical conditions of the emmetropic eye. The rays from distant objects are accurately focused on the retina when the eye is at rest, and the exertion of the accommodation secures the accurate focusing of the rays from nearer objects, as for the emmetropic eye. The conditions of eye-work are thus rendered most nearly physiological. It is toward the establishment of such conditions that the optical therapeutics of myopia is to be directed.

Impairment of Vision.—Myopia renders imperfect the impressions of all objects beyond the far point of the eye. This loss of distinct vision at a distance is attended with a slight gain in the possibility of near vision, but the gain is quite inconsiderable, and on account of the difficulty of convergence this slight gain is of no practical advantage whatever.

Indistinctness of distant vision produces results that might readily be ascribed to other causes. It induces the child to avoid many of the most healthful of childish plays, and to pay more attention to comparatively sedentary occupations and amusements requiring accurate vision only at short distances; and this devotion to pursuits requiring only the exercise of near vision in turn reacts unfavorably on the general health, and especially tends to cause an increase in the degree of myopia.

Strain of Convergence.—While by the restriction of distinct vision to short distances myopia renders convergence more constantly necessary, it also renders it more difficult. The emmetropic eye is a sphere fitting into a spherical socket of orbital tissues, so that its movements meet with comparatively little resistance and entail little exertion. But the myopic eye, having an elongated antero-posterior axis, is ovoid in shape, and rests in an ovoid socket, in which it can only fit when turned a certain direction, and which offers a resistance to its turning much greater than that encountered by the emmetropic eye.

These various factors, tending to make convergence difficult, have such an important influence that nearly all cases of any considerable myopia present an associated insufficiency of convergence or an actual divergent squint. The constant wearing of the correcting lenses will tend to prevent or remedy such difficulties by extending the range of distinct vision to such a distance that it can be habitually enjoyed without any undue taxing of the power of convergence, while the act of accommodation required when near objects are looked at through the correcting lenses tends to the reinforcement of the deficient convergence.

Increase of Myopia.—In a large proportion of eyes the tendency to increase of myopia is only shown during early life, but in cases of high myopia it may persist until sight is lost. This tendency exists to some extent in all cases of myopia at the beginning, for nearly all

eyes, including those that subsequently become myopic, are hyperopic immediately after birth. It has been supposed that this tendency was in large part a normal tendency, and that the increase of refraction in the eye was rather a physiological process ; but there can be no question that in the great majority of eyes in which it goes so far as to produce myopia this change is pathological.[1]

There is thus established in myopia a vicious circle of interaction. The myopia limits distant vision and induces a more constant use of the eyes for near work, and the near work, by the congestion and increased intraocular tension it causes, tends to increase the myopia. This increase of myopia goes on most rapidly during early life when the sclera is more yielding, and in a large proportion of cases the increasing rigidity of the sclera during adult life checks or terminates the process. But if the posterior portion of the sclera is greatly thinned by distension, it never becomes sufficiently rigid to sustain the pressure, and the distension continues to progress throughout life. And such progressive distension is apt to mean the functional destruction of the eye, for the changes in the coats are attended with changes in the media that depend on the choroid for nutrition ; and opacity of the vitreous or lens and detachment of the retina are very liable to ensue.

It is, therefore, of great importance to limit the myopia to a moderate degree in early life, because if this be accomplished it will be possible to entirely check its increase in later life ; and this may in turn be succeeded by a diminution, by the normal increase in the bulk, of the crystalline lens, such as leads in hyperopic eyes to an increase of hyperopia.

Uncomplicated Myopia.—By the use of correcting lenses, distant and near vision are rendered equally available, or distant vision left, as with the emmetropic eye, somewhat the easier. The inducements for the patient to occupy himself exclusively with near vision are thus removed, and with it the tendency to congestion and the excessive efforts of convergence.

It has been supposed that the use of concave lenses might act injuriously by increasing the work of accommodation. But a distinction is to be made between the normal employment of a function and its abnormal exercise, for it is the latter that does the harm—the strain of accommodation, not its use. And if the lens worn is one exactly correcting the myopia, the use of the accommodation it entails is, so long as the employment of the eyes is in other respects normal, exactly similar to the requirements placed upon them for distinct near vision when normal and emmetropic.

To estimate the relative value of this "full-correction" plan of

[1] B. A. Randall, *Trans. Am. Ophthalmological Society*, 1890, p. 657.

optical therapeutics in myopia we have to compare it with the other plans that have been proposed and practised. These are the non-correction of the myopia or its partial correction. The non-correction, and the correction of only such a small part that distinct vision is limited to within less than one-third of a metre from the eye, do not remove the patient's enforced restriction to near vision and its continuous exercise with injuriously great, injuriously constant, and injuriously difficult convergence.

The plan of leaving but three dioptres or less of the myopia uncorrected is open to a somewhat different class of objections. Such incomplete correction leaves the distant vision still notably imperfect and unsatisfactory. But the patient is in this case able to improve his distant vision markedly by looking obliquely through his glasses. The effect of a spherical lens on pencils of rays that pass through it obliquely is that of a stronger spherical lens combined with a cylindrical lens of a certain effect.[1] And this alteration of its refractive power varies with the obliquity of the lens to the pencil. For the strong lenses often required for even the partial correction of the myopia this increase of effect to be obtained by looking through the lens obliquely is very marked, and the patient, without appreciating its significance and danger, is always likely to gain a practical acquaintance with it.

There can be little doubt that the evil results of such incomplete corrections are accountable for much of the prejudice against a complete correction of myopia. The reasoning has been that if these nearly complete corrections proved disastrous, as they certainly often do, then a complete correction would be so much worse. But it must be insisted on that such *a partial correction of myopia is often much more dangerous than a complete correction.* With the complete correction the best vision is obtained when the visual axis is directed perpendicularly to the lens, and any deviation from this relation causes not only the necessity for a greater effort, but allows of less distinct vision; and thus the inducements are all to the avoidance of an oblique position. It will, of course, be borne in mind that to secure the benefits of complete correction such correction must be perfectly accurate—must be based on exact measurements when the eye is fully under the influence of a mydriatic, confirmed by careful testing after the effect of the mydriatic has passed off, to avoid any errors through the presence of aberration or irregular astigmatism.

What has been said thus far about the optical treatment of myopia applies to all cases of simple myopia in which binocular vision is habitually maintained, and where the power of accommodation is what

[1] Jackson, *Journ. Amer. Med. Association,* Nov. 19, 1887; John Green, *Trans. Am Ophthal. Society,* 1890, p. 690.

would be sufficient for the near seeing required of the eye were it emmetropic.

Myopia with Presbyopia.—When a myopic eye loses so much of its power of accommodation that the remainder would not suffice for near work were the eye emmetropic, it becomes necessary to take into account this presbyopia in prescribing glasses for near work. It is to be met by reducing the strength of the concave lens used for such work, or, if the myopia be low, less than three dioptres, it may be needful to discard concave lenses altogether, or even to give a convex lens for near work. The general rule will be to give such a lens as will allow of near work at the required distance with the exertion of not more than one-half or two-thirds of the remaining accommodation.

Myopia complicated by Diminished Acuteness of Vision.—Perfect focusing of the light that falls on the retina is only of value when the sensitiveness of the retina enables it to appreciate any deviation from perfect distinctness of the images formed on it. When the visual acuteness is greatly diminished the distinctness of the retinal image is of less importance than its size. And as a concave lens always diminishes the size of the retinal image in proportion to its strength, it not rarely happens that in high degrees of myopia what is really for practical purposes the best vision is obtained by the use of an incomplete correction. In such a case there will of course be no temptation to increase the effect of the lenses by looking obliquely through them. Much the same indication exists in the case of persons past middle life who have for many years been accustomed to the large indistinct images of high uncorrected myopia, and who find it very disagreeable to make the cerebral effort to recognize objects by a more distinct but smaller and unfamiliar retinal image obtained through the correcting lenses. In all cases, where the indistinct image of incomplete correction is preferred, the chief danger of a partial correction does not exist and the partial correction should be given.

Myopia complicated by Divergent Squint.—In all cases of very high myopia, where much use of the eyes for near vision is required, the effort required to maintain convergence for a distance at which distinct vision is possible without lenses becomes so great that it is given up; and one eye, the one having the better vision, is used, while the other is allowed to deviate outward, establishing a divergent squint. This squint, at first perhaps only temporary and relative, tends with time to become a constant and absolute divergence. Even after binocular vision has been given up, some effort of convergence may still be made from habit. But this effort tends to diminish until it may in time be entirely given up, and near objects be looked at without any effort at convergence.

When in any case this condition of things has been brought about,

the greatest factor in creating the tendency to progressive increase of the myopia has been eliminated, and often, if the excessive use of the eyes is avoided and the sclera be not so far thinned that it is unable to withstand the normal intraocular pressure, the myopia ceases to increase. If this freedom from convergence-effort has been attained, there does not exist the same urgent need for the full correction of the myopia. The only indication for the use of glasses may then be the desire for clear distant vision, and it may be best to allow near work to be done without glasses or with only such glasses as permit of doing it at a convenient distance.

If not only binocular vision, but in addition all effort at convergence, has been given up, it is not advisable to attempt to re-establish binocular vision if the myopia be high, say 8 D. or over. If in a young person with moderate myopia there is an inconstant divergent squint and the patient can to a considerable extent abstain from near work during the period of adaptation, it may be best to give the full correction for constant use, and try to fully re-establish binocular vision if there be no other serious obstacle to it but the myopia. When binocular near vision has been quite given up, but there still remains a decided tendency to exert the convergence when a near object is looked at, great caution must be exercised in the ordering of glasses, or the effort of convergence may be materially increased by association with increased accommodation without the guidance of binocular vision.

Removal of the Crystalline Lens.—The removal of the transparent lens for the partial or complete correction of high myopia, 10 D. and upward, recently proposed by Fukala,[1] is strictly a form of optical therapeutics. It could scarcely be justified in uncomplicated myopia, but is of value in some complicated cases, especially where there exists opacity of the lens that would not alone justify its removal. It cannot do away entirely with the need for glasses, since the destruction of the power of accommodation will make them necessary for either near or distant vision; and more frequently they will be needed for both.

Cylindrical Lenses and Astigmatism.

What has thus far been said of lenses and the dioptric properties of the eye has assumed that their refraction was strictly that of spherical surfaces; that is, surfaces curving equally in all directions. A spherical lens turns all the rays of a pencil of light directly to or from the single unrefracted ray that passes through its optical centre. In contradistinction to these are the form and effect of a cylindrical lens, which is bounded on one or both surfaces by the surface of a segment of a cylinder. Commonly, in the lenses furnished in the trial case one

[1] *Graefe's Archiv für Ophthalmology*, xxxvi., Abth. 2, S. 230.

surface is cylindrical and the other is plane, and as this is the simplest case, a cylindrical lens of this sort will be assumed in the following discussion. Such lenses are represented in Figs. 152 and 153. The

FIG. 152.

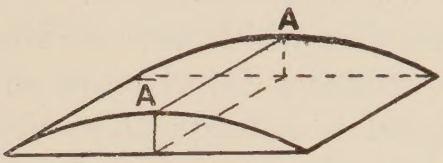
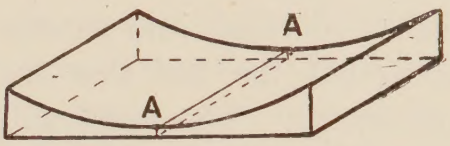


FIG. 153.



line A A, drawn through the centre of the lens parallel to the direction of the axis of the cylinder of which the curved lens surface is a portion, is called the axis of the cylindrical lens. This axis is really the optical centre of the lens, being the thickest part of a convex or the thinnest part of a concave lens. If a section of such a lens be made in the direction of its axis, it will be found to be bounded by two straight parallel lines, so that in this direction the lens has no lens action whatever. And the same is true of any section made parallel to the axial section. But if a section be made perpendicular to the axis, it will be found to correspond exactly to the section of a spherical lens of the same strength, and in the plane of this section the influence of the lens will be the same as that exerted by a spherical lens in every plane.

When a pencil of rays fall on a cylindrical lens, those which pierce the lens in its axis are not refracted at all, but each of them passes on in its original direction like the single ray that passes through the optical centre of a spherical lens. Those passing through other parts of the lens are each turned to or from the corresponding axial ray, according as the lens is convex or concave. But in the direction parallel to the axial plane their course is not affected. The consequence of this sort of refraction is that in any given plane perpendicular to the axis of the lens all the other rays are made to intersect or diverge from the axial ray ; all the rays in this one plane have a common focus, but each of such planes has its separate focus, and the series of these foci form a line parallel to the axis of the cylinder. To give the word "focus" a meaning quite different from its original meaning of "point," the focus of a cylindrical lens is a line parallel to the axis of the cylinder, composed of the foci for the different planes perpendicular to the axis. Bearing in mind that the focus of a cylindrical lens is a line instead of a point, much of what has been said of the foci of spherical lenses is equally applicable to the foci of cylindrical lenses. The focal distance and the strength of the lens have the same reciprocal relation, and cylindrical lenses are numbered in the same way as spherical lenses, the focal distance in inches or the dioptres of refractive power having the same significance.

Regular Astigmatism.—Astigmatism is that defect in the refraction of the eye whereby rays coming from a single point in front of it are turned not toward any single point within or behind the eye, and whatever the situation of the retina, it can receive only a diffused and imperfect impression of the point from which the rays come.[1] Astigmatism is divided into regular and irregular, which have nothing in common but the fact that they cause necessary imperfection of the retinal image. The latter will be referred to subsequently: we will now consider only regular astigmatism, and where the word "astigmatism" is used without the qualifying adjective, it is to be understood that regular astigmatism is meant.

Instead of a spherical surface curving equally in all directions, or a cylindrical surface curving in one direction and not curving at all in the direction at right angles to this, we may have a dioptric surface curving, like the edge of an ordinary watch, in all directions, but more in one direction than another. It is such a curvature in one of the dioptric surfaces of the eye, usually the anterior surface of the cornea, that gives rise to regular astigmatism. Such a surface causes the rays of an optical pencil all to converge toward the central ray, but to converge more rapidly in some directions than in others. So that in astigmatism the rays coming from a single point are not brought to a single point within the eye, but to two focal lines perpendicular to each other and situated at different distances back of the cornea. The direction in which such a dioptric surface curves most and the direction in which it curves least are called its *principal meridians.* For regular astigmatism these principal meridians are always exactly perpendicular to one another.

The astigmatism is to be corrected by the proper placing before the eye of the proper cylindrical lens. This lens must always be just strong enough to make up the difference between the refractive powers of the two principal meridians. If a convex lens is used, it must be so placed that its curve will be in the direction of the weaker curve of the cornea, the action of which it will sufficiently supplement to make it equal to the refractive power of the stronger meridian. If, on the other hand, a concave cylindrical lens is employed, it must be placed with its curve parallel to the stronger meridian of the eye, the refractive power of which it will so far neutralize as to leave the equivalent of the refractive power of the weaker meridian. In designating the direction in which a cylindrical lens is to be placed before the eye reference is commonly made to the direction of its axis, which is perpendicular to the direction of the curve of the lens that is to be placed in juxtaposition in one or the other of the principal meridians of the cornea.

[1] For an extended treatise and bibliography see *A Theoretical and Practical Treatise on Astigmatism*, by Swan M. Burnett, M. D.

Different Forms of Astigmatism.—The cylindrical lens corrects the astigmatism, but it may not by itself correct all the ametropia. The astigmatism is corrected when all the rays of an optical pencil after passing through the dioptric surfaces of the eye tend to a single point, whether that point be on the retina or in front of it or behind it. If the focus be exactly on the retina, the whole of the ametropia has been corrected. But much more frequently that focus will be materially in advance of or behind the retina, and then there will still remain a corresponding amount of myopia or hyperopia to correct by the addition of the appropriate concave or convex spherical lens.

There are five different possible positions of the retina with reference to the focal lines in any given case of astigmatism, which different positions are represented in Fig. 154. If the retina is in front of both focal lines, the eye is hyperopic in all meridians, and the astigmatism is called *compound hyperopic astigmatism.* If the retina passes through the anterior focal line, the eye is emmetropic for one meridian of the cornea and hyperopic for the other, and the defect is called *simple hyperopic astigmatism.* If the retina passes through the posterior focal line, the eye is emmetropic in one meridian and myopic in the other, constituting *simple myopic astigmatism.* If the retina is behind both the focal lines, the eye is myopic for all meridians, and the defect *compound myopic astigmatism.* When the retina it situated between the two focal lines, so that the eye is hyperopic for one principal meridian and myopic for the other, the case is one of *mixed astigmatism.*

FIG. 154.

Position of the Retina in Astigmatism: 1, compound hyperopic; 2, simple hyperopic; 3, mixed; 4, simple myopic; and 5, compound myopic astigmatism.

Various Corrections for the Same Case.—When the astigmatism is hyperopic, it is customary to use a convex cylindrical lens, placing it so that it will bring the focal lines together by bringing the posterior forward to the anterior, so that the focus will fall at the position of the anterior focal line. Then, if it is a case of simple astigmatism, the focus will fall on the retina without any additional lens effect. But if it be a case of compound hyperopic astigmatism, the focus will still lie behind the retina, the position of the anterior focal line having been back of the retina, and to bring it forward on to the retina, to correct the remaining hyperopia, requires a spherical lens in addition. In the same way, for myopic astigmatism a concave cylindrical lens is commonly employed, so placed as to carry back the anterior focal line and bring the focus at the position of the posterior focal line, correcting simple astigmatism by the cylindrical lens alone, and for compound

astigmatism requiring a concave spherical lens added, on account of the myopia remaining after the astigmatism has been corrected.

With mixed astigmatism one has the option of either carrying the posterior focal line forward with a convex cylindrical lens, and then bringing the focus back to the retina with a concave spherical lens, or of carrying the anterior focal line backward with a concave cylindrical lens to the posterior focal line, and then bringing the focus forward on the retina with a convex spherical lens.

But there are other ways of constructing the correcting formula in either of these cases. In hyperopic astigmatism we can use a concave cylindrical lens, carrying the anterior focal line backward with it, so as to form the focus at the position of the posterior focal line, and then using a stronger convex spherical lens to bring the focus forward to the retina. Or in the case of myopic astigmatism the convex cylindrical lens can be used to carry the posterior focal line forward to the anterior focal line; this would be taking it away from the retina, but the focus could be brought back to the retina with a stronger concave spherical lens. Or, finally, in any case of astigmatism by the use of a certain cylindrical lens for each of the focal lines these could both be brought to the retina separately. Thus for any case of compound or mixed astigmatism there are three distinct formulæ, optically equivalent the one to the other, either of which can be used to correct the astigmatism in a given case. For simple astigmatism these three formulæ are reduced to two.

The method requiring the use of two cylindrical surfaces with their axes placed exactly at right angles to each other is objectionable. Such a lens is very difficult to grind with perfect accuracy, and is therefore expensive, while it possesses no advantages over one of its sphero-cylindrical equivalents. It should therefore not be prescribed, but the choice should fall on one of the other combinations. The one commonly employed has already been indicated; it is, in general, the one in which the cylindrical is made to act on the worse meridian, and therefore the spherical is weaker than in its sphero-cylindrical equivalent. But under the head of Periscopic Lenses is given some reason for choosing the latter combination.

Clinical Indications for Cylindrical Lenses.—*Blurring of Vision.*—Astigmatism causes some indistinctness of both near and distant vision—not nearly so much blurring as is caused by an equal amount of uncorrected hyperopia or myopia, but still enough to be very noticeable if the astigmatism be of medium or high grade, say over one dioptre in amount. But low grades of astigmatism, and sometimes even the higher, causing a great deal of trouble in other ways, may exist, although the patient has not been conscious of any imperfection of vision. The imperfection of sight caused by astigmatism is very apt to be called

"near-sightedness," although the eye may really be hyperopic, because it leads the patient to bring objects closer to his eyes to obtain increased size for his retinal images to balance their indistinctness. The effect of this blurring on the reading of test-type is often quite peculiar: the patient will miscall certain of the larger letters and yet read correctly some of the much smaller letters. This is because the blurring affects chiefly or wholly lines running in certain directions, while the lines in another direction are quite clear.

We perceive a line by perceiving the impressions made by the luminous points that compose it. Now, in astigmatism one of the focal lines is the best image of a point that can fall upon the retina, and when it does each point gives rise to the visual impression of a line. Now, when the line looked at happens to run in the direction of the focal lines that fall upon the retina, these focal lines will overlap each other and not the space bordering the line; and no blurring of the line will result, except at the ends. If, however, the line does not run in the direction of the focal lines that fall on the retina, the linear image of each point will overlap the images of points outside the line, and blurring of the sides of the line will result. This peculiar blurring of the lines in astigmatism is made the basis of most of the subjective tests for the defect.

In any case, to get perfectly distinct vision, either near or distant, the astigmatism must be corrected. And if the vision have been quite imperfect before the correcting lenses have been employed, it very generally happens that it does not immediately reach the normal standard with them, but apparently the whole visual apparatus has to undergo a process of training before it can fully appreciate and avail itself of distinct retinal images. Hence the full visual benefit derived from optical therapeutics in astigmatism cannot be estimated, often, until weeks or months after the wearing of the correcting lenses is commenced.

Eye-strain from Astigmatism.—To what extent the eye can, by partial or unequal contraction of the ciliary muscle, strictly correct astigmatism is uncertain. Cases are recorded—and such have been met with by most ophthalmic surgeons—that to some extent possess this power, but eyes possessing it to a notable degree must be regarded as exceptional. Where it exists it is liable to be exerted whenever the eyes are used for accurate seeing, and thus become a source of eye-strain. But, though this power of truly neutralizing the astigmatism be absent, the astigmatic eye is especially liable to strain of accommodation; for at any given time it can only see clearly the lines running in one direction, and by an effort of the accommodation can render clearer the lines running in other directions. As almost every object looked at presents lines running in various directions, the need for such adjust-

ments of the ocular focus is about as constant as the use of the eyes, and the tension of the ciliary muscle has to undergo extremely frequent variations. Hence astigmatic eyes are pretty certain to suffer more or less from the effects of eye-strain. Such eye-strain is manifested by any of the symptoms referred to under that general head—local inflammations, headache, or reflex motor disorders—but has little especial tendency over eye-strain from other causes to give rise to one form of disturbance rather than another, although by some it has been particularly connected with conditions of intraocular congestion or irritation.[1]

When Cylindrical Lenses should be Worn.—The mere existence of astigmatism, if it does not impair vision to an undesirable extent or cause any eye-strain, does not demand the wearing of cylindrical lenses. But before deciding that no eye-strain exists the extremely wide range of phenomena that may be due to eye-strain must be considered. The existence of any one of them may constitute a sufficient indication for the use of lenses. If, however, lenses are needed at all, it is far better that they should be worn constantly. The strain is greater, of course, the more minute the objects to be looked at and the more accurate the vision required; but it must be remembered that astigmatism affects the vision for all distances and for all sorts of objects, and the greatest relief is to be obtained by removing all the strain possible. And if cylindrical lenses are worn intermittently, the eye becomes accustomed to clear vision with them, and is more persistent in straining after it when the glasses are left off. During these latter periods more harm may very readily be done than the good of wearing the glasses a part of the time can compensate for. The only exception to the rule of constant wearing of cylindrical lenses that can be made without serious detriment to the patient is in the case of persons who have so far lost the power of accommodation that they are in no danger of straining it, and who care but little for distinctness of vision except on special occasions.

The strength of the cylindrical lens should in all cases be that which fully corrects the astigmatism, and should be the same for all distances, though the result may be effected by either of the optical equivalents to which reference has been made. Thus a case of myopic astigmatism may require a concave cylindrical correction for distant vision, while if presbyopia coexist it may be most simple to use the convex cylindrical lens, with its axis at right angles to that of the former, for near vision.

Astigmatism usually coexists with the other forms of ametropia.

[1] W. Thomson, "The Connection between Staphyloma Posticum and Astigmatism," *Amer. Journ. of the Med. Sciences*, October, 1875, p. 383.

Two-thirds of all eyes[1] presenting indications for optical therapeutics show a notable astigmatism (one-quarter dioptre), and fully one-third show double that amount and upward. The latter should have it corrected if for any reason they are required to wear glasses. Indeed, if for reasons other than the astigmatism the glasses are to be worn constantly, it is generally better to have even one-quarter of a dioptre of astigmatism corrected. And sometimes the correction of even this small amount will alone produce a notable benefit, although cases of this kind are exceptional, occurring in patients unusually susceptible to the influence of eye-strain.

While astigmatism shows no general tendency to increase, it does in a minority of cases vary from time to time, and increases more frequently than it diminishes.[2] Such changes in amount will of course demand a corresponding alteration in the cylindrical lens used in its correction.

Aberration and Irregular Astigmatism of the Eye.—Although it is frequently convenient, and in the case of weak lenses sufficiently correct, for all practical purposes to assume that a spherical lens focuses all the rays of a pencil of light to a single point, this is not strictly accurate. As a matter of fact, the centre of the lens is weaker than the periphery, and in the case of strong lenses—that is, lenses of short focal distance as compared with their size—this variation of refractive power is very marked. Thus near its edge the 12 D. lens from the trial case has a strength of about 13 D. A similar condition occurs in the eye, the refraction varying from the centre of the pupil toward its margin. In the eye, however, the refractive power is not always least at the centre and greatest at the margin of the pupil, though usually so. This form of ametropia has been designated the *symmetrical aberration*[3] of the eye. When, as in the spherical lens, the refraction is greatest at the margin, so that the eye is more hyperopic or less myopic at the centre of the pupil, it is called *positive aberration.* When the reverse is the case, and the eye is more myopic or less hyperopic at the centre of the pupil, it is *negative aberration.* In the majority of eyes the aberration does not materially influence the selection of the correcting lens; but in not a few it becomes in this connection of practical importance.

This source of error in the prescribing of lenses may be guarded against to some extent by trying the eye with the lenses after the effect of the mydriatic has passed off. When the aberration is negative, it

[1] Jackson, "The Absolute Static Refraction of the Eye," *Trans. Amer. Ophthalmol. Soc.*, 1889.

[2] Ibid., "Progressive Hyperopic Astigmatism," *ibid.*, 1890, p. 676.

[3] See paper by the writer in the *Trans. Amer. Ophthalmological Society* for 1887, with accompanying discussion.

may happen that it is absolutely essential to diminish the strength of the convex lens fixed upon under mydriasis. More frequently it will be needful to use a slightly stronger convex or weaker concave lens than was accepted under the mydriatic, on account of positive aberration. The variation demanded on this account is rarely a half dioptre, yet the failure to recognize this indication may make the difference between success and failure in the optical therapeutics of the particular case.

Very high degrees of negative aberration are produced by an approach of the cornea to a conical form, and defects of this kind have long been known by the name of *conical cornea*. With the aberration in these cases there is generally associated a good deal of regular and irregular astigmatism, which are to be met by the measures suggested in connection with the latter condition. Lenses have been proposed, however, and to a very limited extent employed,[1] especially designed to correct such a defect. They are called *hyperbolic lenses*, one side having something the curve of a concave hyperboloid of revolution, curving more at the centre and less toward the margin, while the other surface can be ground to such spherical or cylindrical curve as may be required. When such a lens is used the patient must look through a certain part of the hyperboloid surface to get its best effect. Lenses of this kind have but a very limited application, although of positive value in a few cases.

Irregular Astigmatism.—While we speak of the mass of eyes as "corrected" by spherical or cylindrical lenses or their combinations, there are in all eyes slight deviations of the dioptric surfaces from mathematical exactness that cannot be "corrected." But it is only when these irregular deviations from any symmetrical form are the most prominent feature of the ametropia that the case is spoken of as one of irregular astigmatism. This may be the case when the cornea is left faceted or irregular in shape after phlyctenular or interstitial keratitis, or the lens exhibits the irregular refraction that often precedes cortical cataract. Such irregularities give rise to imperfect, distorted, or multiple images of each luminous point looked at. Fick[2] suggested the employment of a glass shell called a *contact lens* made optically continuous with the cornea by the interposition of a non-irritant solution having the same index of refraction as the cornea itself. This does remedy the defect in so far as it is due to irregularity of the anterior surface of the cornea, but it has not been utilized in practice.

Irregular astigmatism will commonly be found to be associated with regular astigmatism, and the careful measurement and correction of the

[1] Hay, *Trans. Amer. Ophthalmol. Society*, 1885, p. 724, and Raehlmann, *Zehender's klinische Monatsb. für Augenheilk.*, Jahr. xx. P. iii.

[2] A. E. Fick, *Archives of Ophthalmology*, 1888, p. 215.

latter will be a notable benefit to the patient. Where such regular astigmatism does not exist, it is often a great help to order the strongest convex spherical lenses that can be worn without notably impairing the distant vision, since these place the eye in the condition in which it is least likely to fret and strain the accommodation. If all lenses are found useless, vision may still in some cases be improved by the use of *stenopaic spectacles*. With these the patient looks through a minute opening or a narrow slit in an opaque disk, such an apparatus having the effect of lessening the diffusion areas on the retina and improving the vision in any kind of uncorrected ametropia.

Anisometropia.—Anisometropia, or inequality in the refraction of the two eyes, is, if we apply the term to all cases in which the refraction of the two eyes perceptibly differs, the general rule, to which the exceptions are comparatively few. Sometimes the use of the term is restricted to those cases in which there are different kinds of ametropia present in the two eyes, as hyperopia in one and myopia in the other; but for all practical purposes difference of degree in ametropia of the same kind has precisely the same significance, and is here included under the term "anisometropia."

The indications that this condition presents for optical therapeutics are two: the impairment or complete loss of binocular vision by reason of inability to focus the light from any given object on both retinas at the same time, which occurs with the higher degrees of anisometropia; and eye-strain, from the effort so to co-ordinate the impulses sent to the various muscles concerned in clear binocular vision, when the anisometropia is of such low degree, that it is possible by especial exertion of one or the other ciliary muscle to overcome it. The lower grades of the defect therefore lead to eye-strain, the higher to imperfect vision. Just when a special instance of anisometropia will fall in one class and when in the other will depend on age and on idiosyncrasy of accommodative action. The researches so far recorded[1] seem to indicate that the healthy young adult cannot commonly overcome much more than one dioptre of anisometropia.

The proper treatment for the great mass of cases is the accurate correction of the ametropia in each eye, and so the correction of the anisometropia. This should always be tried for cases in which the difference is one dioptre or less, and for many of somewhat higher degree. In the higher grades of anisometropia we encounter an obstacle to such a course which is frequently insurmountable: this is the unequal prismatic action of the edges of the correcting lenses. At the optical centre of a lens there is no prismatic action, but it appears and increases as we go from the centre at a rate proportioned to the

[1] A. Fick, "Unequal Accommodation in Healthy Eyes and in Anisometropia," *Archives of Ophthalmology*, 1889, p. 292.

strength of the lens. When, therefore, the lenses are of different strength, their prismatic actions for points equally removed from the centres are different, and as the edges of very different lenses are approached this differerence of prismatic effect causes actual diplopia, or serious strain of the extraocular muscles to prevent diplopia. Thus in the case of lenses differing one dioptre in strength, when the point looked through by each eye is one centimetre from the optical centre of its lens, the difference in prismatic effect will be one centrad, or a little more than that of a one degree (refracting angle) prism—an amount that will in many cases lead to strain if the displacement be in the vertical direction. By confining the eyes to the use of the portions of the lens in the immediate vicinity of the optical centre it is practicable to have greater differences than this between the lenses used, and it is often worth while to make the trial.

The Prescribing of Lenses.

When only a spherical lens is to be prescribed, it is essential to express the kind of lens—that is, whether it is to be convex or concave—and its strength. The kind is usually expressed by the sign + for convex, and the sign − for concave, though sometimes the words themselves or abbreviations of them are employed. The strength is expressed by the number of the lens in dioptres. In addition to these we may, if we desire, indicate the variety of lens to be used, as double convex, plano-convex, or periscopic convex.

Periscopic lenses have the advantage that when the visual axis is directed toward some point away from the optical centre there is less change in the lens effect from obliquity to the pencil of rays than is produced with lenses of other forms. This advantage is, however, shared to some extent by lenses with one plane surface if the curved surface when convex be turned from the eye, aud when concave be turned toward it. In general whatever the kind of lens, it should be mounted so that the more convex or less concave surface shall be turned from the eye.

When a cylindrical lens is to be prescribed, it is needful in addition to the kind, + or −, and strength, to indicate that the lens is cylindrical, in contradistinction to spherical, by an abbreviation, as *c.*, *cy.*, or *cyl.*, and also to state clearly the direction in which the axis must be turned. Various systems of expressing the direction of the axis have been devised and used. They all do it by giving the number of degrees that the axis diverges from some fixed line taken as the base line. The method almost universally employed in America, and the one conforming most nearly to the notation of other branches of mathematics, will alone be here referred to.

It begins with the horizontal line as zero, and gives the number of

degrees the axis diverges from this, beginning with lines going upward and to the right as the surgeon looks at the patient from in front, and, as shown in Fig. 155, representing the graduation of a trial frame. The angle continues to increase, passing the vertical at 90 degrees, until at 180 degrees the horizontal line is again reached. Going beyond

Fig. 155.

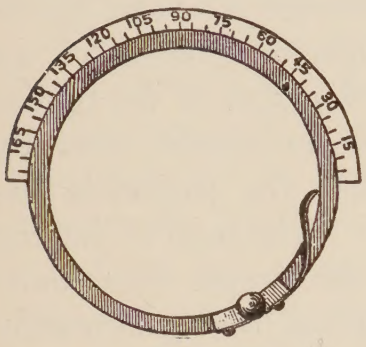
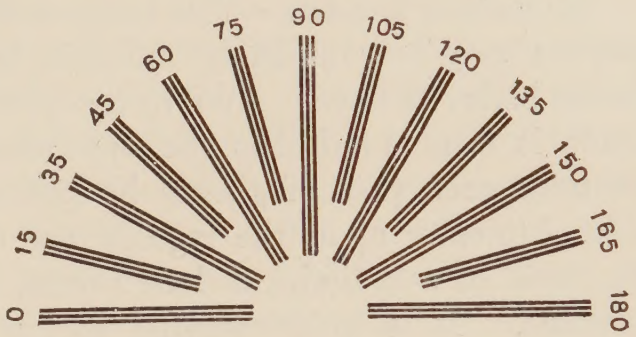


Fig. 156.



this, we have only meridians already numbered at the other end. Of course from the patient's point of view the direction of the numbering is reversed, starting downward from the right, as shown in Fig. 156, representing an astigmatic test-card.

For the great majority of eyes both cylindrical and spherical lens effects must be supplied in the same glass, and this is indicated by the symbol ⌒, meaning "combined with." The same sign is used to indicate the combination of a prism with a lens.

For the different parts of an optical prescription there is no single order universally employed. The order commonly observed by the writer is given in the following examples of optical prescriptions, the first letter or letters indicating as to whether the glass is for the right or the left eye, R. or O. D. indicating the right, and L. or O. S. standing for the left eye. In using the metric system of numbering lenses the decimal point should be carefully placed for the numbers indicating the lens strength :

Formula for spherical lens, R. + 1.25 sph.

Formula for cylindrical lens, L. − 1. cyl. axis 175°.

Sphero-cylindrical lens, L. + 1.25 sph. ⌒ + 1. cyl. axis 85°.

Sphero-prismatic, R. + 2.50 S. ⌒ Prism 2°, base in.

Cylindro-prismatic, R. + 1.75 cyl. axis 90° ⌒ Prism 1°, base out.

Sphero-cylindro-prismatic, R. − 4. sph. ⌒ − 2. cyl. ax. 180° ⌒ Prism 3°, base in.

To secure the advantages of a periscopic lens when a cylindrical lens has to enter into the combination toric lenses have been employed.[1] Such lenses have one toric surface ; that is, such a surface as is developed by the revolution of an arc about a line parallel to the chord which bounds it. The practical benefits of a periscopic lens, can, however,

[1] G. C. Harlan, *Trans. Am. Ophthalmological Society*, 1889, p. 433; John Green, *American Journal of Ophthalmology*, March, 1886, p. 53.

usually be attained by using a convex spherical in combination with a concave cylindrical, or *vice versâ*. For instance, instead of the spherocylindrical combination given on the previous page the following optical equivalent can be substituted.

L. + 2.25 sph. − 1. cyl. axis 175°, with the cylindrical surface turned toward the eye.

Mounting Lenses.—The best-considered measures of optical therapeutics may be completely nullified by an imperfect placing of the lenses before the eye. And in the present development of the optical trade it is essential that the ophthalmic physician should carefully examine each pair of glasses he prescribes before the patient is permitted to enter upon the regular use of them.[1] The need of having the axis of a cylindrical lens turned in just the proper direction is obvious. It is quite essential to have the optical centre accurately placed, else hurtful prismatic effects are produced like those attending the use of lenses of unequal strength, already referred to in the account of Anisometropia, only that in this case the prismatic action and the diplopia or strain caused are constant through whatever part of the lenses the patient may look. It is equally important that the lens be placed so that the visual axis will be perpendicular to it when the eye is in use. For this purpose the lens should face almost directly forward, very slightly downward if it is to be used for distant vision, or much more decidedly downward if it is to be used only for near work, since objects for near vision are almost invariably held considerably below the level of the eyes. And if the same glass is to be used for both near and distant vision, a compromise position must be given, and it becomes a matter of greater importance to have the lenses periscopic, so that the visual axis shall be more nearly perpendicular to it in all positions of the eyes.

Bifocal Lenses.—Where lenses are required for near vision different from those used for greater distances, these may be mounted in separate frames or both arranged in the same frame so that distant vision is clear through the upper, and near vision through the lower, portion of the lens. These latter are called bifocal lenses. They are made by the placing of two half lenses in the frame, leaving a horizontal line of separation, or by making the distance glass fill the frame, and cementing on it a small segment of a convex lens to aid near vision. Bifocal lenses should in general be so mounted that the stronger part of the lens will be the more nearly perpendicular to the direction of the visual axis passing through it, the stronger lens being the upper part of a concave lens and the lower part of a convex lens.

[1] Jackson, "Fitting Spectacle-Frames to the Face," *Am. Journ. of Ophthalmology*, 1888, p. 50; C. H. Thomas, "Construction and Adaptation of Spectacle-Frames," *Trans. Philadelphia County Medical Society*, 1891.

To secure the proper position of the lenses the frames in which they are mounted must be well fitted to the face and substantial. The frames which most generally meet these requirements are the hook-temple spectacle frames, which are especially important for strong cylindrical or concave spherical lenses. Any distortion of the frames or displacement of the lenses, if not promptly rectified, is liable to cause all the symptoms of eye-strain.

The Period of Adaptation.—The wearing of any lens, no matter how accurately it corrects an existing ametropia, no matter how urgently it is indicated, if it materially change the conditions of eye-work will very probably be for a time resented. The use of a spherical lens changes the relations between accommodation and convergence. The cylindrical lens to some extent does the same thing, and changes the apparent shape of objects and disturbs the relations of parallelism of the meridians of the two eyes. The correction for hyperopia is apt, through continued excessive activity of the accommodation, to prevent clear distant vision. The use of strong concave lenses causes difficulty in accommodating for near work. Such unpleasant effects are temporary, but their gravity and duration depend on the extent of the change wrought in the conditions of eye-work, the age of the patient, and the constancy with which the glasses are worn.

Commonly, it can safely be predicted that the patient, if an adult, will not get the best help from his glasses for at least four or six weeks, although they may be of some, and even of essential, assistance from the start, while in some cases the first wearing of them causes a material increase of discomfort. To avoid the unpleasant phenomena of this period of adaptation many have resorted to the giving of incomplete corrections. But by such a course, if anything be gained in diminished severity of the symptoms at the start, it is likely to be balanced by their longer continuance, and other dangerous factors may be introduced to complicate the trouble, as in myopia. Something can be done by bringing strong cylindrical and concave spherical lenses very close to the eye or by commencing the use of strong convex lenses while the eyes are still well under the influence of a mydriatic. But the practical point of the greatest importance is the preparation of the patient's mind for such annoyances by explaining them to him at the time the lenses are ordered, and getting him to agree not to discontinue the steady wearing of the glasses. If the patient will agree to this, and is not too old for the radical change to be wrought, and if the lenses have been accurately selected, an entirely confident prognosis of radical relief in a few weeks from the annoyances of adaptation can be given, and usually in a very few days of faithful wearing of the lenses a perceptible amelioration of the symptoms occurs.

INJURIES OF THE EYE AND ITS APPENDAGES.

By F. BULLER, M. D.

Injuries of the Eyelids.

Wounds.—Wounds of the eyelids, when not extending through the thickness of the lid and unaccompanied by injury of the eyeball or deeper structures, are comparatively harmless. Their treatment should consist in careful cleansing with some antiseptic solution, of which bichloride of mercury 1 : 2000 or 1 : 3000 is perhaps the best, and accurate coaptation of their edges by means of fine silk—Nos. 2 or 3, iron dyed, being the most suitable for the purpose; the needles used should be fine and sharp. It is always well to insert a sufficient number of sutures to secure perfect apposition throughout the length of the wound. A pledget of lint, sprinkled with finely powdered iodoform should be laid over the parts, then a sufficient thickness of absorbent cotton to keep the lids at rest, when all may be secured with a compressive bandage. The compressive bandage so commonly used in ophthalmic practice should be two inches wide and about two yards in length. It may consist of almost any fine, soft material of wool or cotton. The best material for this purpose is the so-called English water-dressing bandage, but in the absence of this cotton cheese-cloth or very fine flannel will answer the purpose almost as well. In applying such a bandage to one eye the free end should be laid upon the brow over the affected eye; then the bandage is rolled around the head to the starting-point, thence carried above the opposite ear, below the occiput and corresponding ear, thence upward over the eye to the brow, where it may be fixed with an ordinary pin. Thus applied, the bandage is sufficiently secure and admits of employing any desired degree of pressure. After two or three days the bandage may be removed, the dressing soaked off with warm water, and the stitches removed. Even when the wound of the skin has been large and lacerated, this treatment seldom fails to bring about perfect union without a perceptible scar.

Wounds involving the whole thickness of the lid, and especially

those in which the lid edges have been divided, are of far more importance, inasmuch as their imperfect union frequently leads to a most annoying and conspicuous deformity. This is particularly true of those cases in which the lids, one or both, have been divided at or near their inner extremities. When the lesion is in this situation there is the further difficulty that the canaliculi are apt to be divided, and it may be impossible to restore the continuity of these important structures. Wounds through the whole thickness of the lid not only gape widely, but they are liable to become contaminated by secretion from the conjunctiva: for this reason the entire conjunctival sac must be thoroughly cleansed with bichloride solution, as well as the wound itself and the outer integuments, before the parts are united. When this has been done, lacerated parts being trimmed with as little loss of substance as possible, fine black silk aseptic sutures may be put through the entire thickness of lid in sufficient numbers to bring the cut surfaces thoroughly together. As a rule, two or three deep sutures and a few more superficial ones will suffice. It is advisable to unite the muco-cutaneous edge of the lid also with one fine suture, and thus avoid the slight notch that might otherwise occur. If a canaliculus is divided, an effort should be made to restore its continuity by inserting, if possible, a fine lead wire through both portions, keeping it in place as the parts are brought together. A dry dressing of iodoform and absorbent cotton may be retained undisturbed for two or three days, and then carefully removed, when some or all of the stitches may be taken out and a similar dressing reapplied for a day or two longer. Under no circumstances should reliance be placed on sticking plasters, or one or two coarse sutures roughly inserted—a method of treatment unfortunately still too common in general practice.

Burns and Scalds.—Extensive burns or scalds, involving only the cutaneous surface of the lids, demand the same treatment as similar injuries elsewhere, except that when the inevitable retraction from such injuries threatens to expose the eyeball permanently, the edges of the lids should be pared and the fresh surfaces united by three or four fine sutures through the thickness of each lid: a small portion at each end of the lid may be allowed to remain ununited for the escape of conjunctival secretion. If the integument is already considerably shortened, undue traction on the united lid-edges may be avoided by a longitudinal incision parallel to and about 3 millimetres from the border of the lid; the little gaping wound may be covered with a shaving of skin from the hairless inner surface of the arm or forearm. A skin-graft of this kind, a quarter of an inch wide and three-quarters of an inch long, will be found firmly united and of a rosy color five days after it has been applied; but in removing the dressing very great care is necessary in order that it may not be disturbed. The

united lid should not be separated until all danger of further cicatricial contractions has passed.

Injuries of the Conjunctiva.

Wounds of the Conjunctiva.—Unless these are extensive they only require cleansing of the sac with bichloride solution, 1 : 5000, and a light antiseptic bandage over the eye for a day or two. Undue secretion from the conjunctiva, if present, will soon subside if the eye is washed several times daily with a saturated solution of boric acid.

Extensive Lacerations of the Conjunctiva may be repaired by inserting fine silk sutures as required. If the laceration involve opposing surfaces of lid and eyeball, one or both of these must, if possible, be covered with healthy conjunctiva, otherwise union of the opposing raw surfaces (symblepharon) will ensue. In order to cover the denuded part it will sometimes be necessary to bring the conjunctiva up from one or both sides of the wound.

Scalds and Burns of the Conjunctiva are of frequent occurrence, and often disastrous in their results. They are produced either by the direct action of destructive chemical substances, such as lime, ammonia, lye, or strong acids, or by heated substances projected against the eye, such as hot water, steam, burning fluids or gases, or molten metals. Of this class of injuries the last mentioned is perhaps the most common. Injuries by gunpowder and other explosives are often of a complex nature, involving more or less burning or scalding of the parts, with impaction or penetration of foreign bodies in the eye or surrounding structures, and there may be any degree of contusion or laceration of the injured parts. Injuries from chemical substances such as have been mentioned are for the most part instantaneous, and their destructive action has usually been accomplished before relief can be obtained. If circumstances render it possible to plunge the face and eyes immediately into water, some benefit might result from such a procedure; the caustic substance might work less deeply and intensely than if left undisturbed. In the case of lime or other caustic substance not in liquid form the surgeon may perhaps arrive in time to remove a part of the irritant before it has worked its full effect. In any case he would proceed without delay to wash or otherwise cleanse the eye from all irritating foreign substances. A few drops of cocaine solution will greatly facilitate the necessary manipulations, particularly that of everting the lids, which are likely to be spasmodically contracted. A syringe, tepid water, and some sort of small smooth spatula are all the instruments required for this cleansing process. This being accomplished, the patient may be rendered more comfortable by the application of soothing remedies, and something may be done in the way of keeping within bounds the subsequent inflammatory

reaction. The pain which follows such injuries is best relieved by occasional application of an ointment of cocaine in vaseline, 2 or 3 grains to the drachm, introduced beneath the upper eyelid, and for some hours or days, as the case may be, absorbent cotton compressors steeped in cold saturated solution of boric acid may be applied. When, however, the cornea has been injured cold applications cannot safely be long continued, as they lower its vitality and tend to induce destructive ulceration. Whenever the cornea shows a commencing ulceration warm applications are indicated. If moist warmth is chosen, the fluid should be some mild antiseptic, such as a solution of boric acid, 10 grains to the ounce, or a solution of bichloride of mercury, 1 : 10,000, or carbolic acid, 1 : 1000. The application of warm fomentations is likely to be wholly inefficient unless explicit instructions are given to the patient or attendant. The quantity of liquid used for this purpose should not be less than two or three quarts, and the temperature should be as high as the patient can bear without actual discomfort. Many devices for applying moist heat to the eye have been invented ; but a soft aseptic sponge about the size of the closed hand or a mass of clean (not absorbent) cotton wool of the same size will meet all ordinary requirements. The patient may sit with the face over a chair on which is placed a crockery bowl large enough to contain readily the required quantity of liquid, and, sopping the sponge in this, press it gently to the closed lids for half a minute, then remoisten, and continue the process at similar intervals for fifteen or twenty minutes. The fomentations may be applied in this manner three or four times daily.

Although cocaine may be used at first for the relief of pain, when inflammatory reaction has set in atropine is the better remedy, and may be used in solution, 2 to 4 grains to the ounce, or as an ointment in vaseline, of the same strength. Solutions of atropine commonly do not keep well, but if made with sterilized water, to the ounce of which half a grain of salicylic acid has been added, and kept in a well-stoppered phial, the solution will remain clear for a long time.

This class of injuries may destroy vision immediately by extensive and irreparable damage to the cornea, causing either its immediate and total destruction, or by converting it into a hopelessly opaque substance. The gravity of injuries from quicklime or strong ammonia is often not appreciated by inexperienced observers, who are consequently liable to serious errors of prognosis. When an eye has been injured by either of these substances to the extent of denuding the anterior sclerotic for the greater part of its vascular conjunctival covering, so that the visible sclera has an abnormally white appearance within a few hours or a day or two after the injury, no matter how free from opacity the cornea may appear under these circumstances, the prognosis is extremely

grave, since it is impossible for these powerful escharotics to have destroyed the ocular conjunctiva extensively without grave injury to the cornea; which cannot fail to result in total loss or incurable opacity of this membrane. The writer has seen cases of total leucoma following lime-burns in which the cornea appeared fairly clear for a whole week after the injury, and in the case of a physician who had both eyes injured by strong liquor ammoniæ, the left eye was thought by his medical attendant to be in a satisfactory condition five days after the injury, when in reality the seemingly pellucid cornea was only represented by Descemet's membrane, the entire corneal substance having been destroyed and exfoliated. Another unfavorable feature about injuries from corrosive chemicals or molten metals is that opposing surfaces of ocular and palpebral conjunctiva are liable to be destroyed, so that in healing two raw surfaces come together and form adhesions between the eyelid and eyeball (symblepharon) which it may not be possible to prevent by any of the innumerable plans hitherto suggested for this purpose. As might be expected, adhesions from this cause mostly affect the lower lid, the cicatricial band of union often extending far over to the surface of the cornea when healing has been accomplished, thus giving rise to an unsightly opacity, and perhaps to impairment of vision when the pupillary area has been encroached upon. Besides this, there may be a constant annoyance from a dragging feeling when the eye is moved. Even without the conditions necessary for the formation of symblepharon, a burn of the ocular conjunctiva involving a corresponding portion of the corneal surface may readily give rise to a growth of tissue resembling a pterygium, which not only causes disfigurement of the eye, but may, by encroaching on the pupillary area, seriously impair vision. These traumatic pterygia are always more difficult to deal with than the ordinary spontaneous form of this affection. The development of a traumatic pterygium may sometimes be prevented by scraping the raw or granular surface from which it is about to develop and grafting the same with healthy conjunctiva. This little operation, however, is by no means certain of success.

Foreign Bodies in the Conjunctiva.—Foreign bodies imbedded in the conjunctiva do not always necessitate interference on the part of the surgeon; thus we often see small particles of metal or grains of powder on the surface of the sclerotic which have been there for years without occasioning the slightest inconvenience. If, however, a foreign body in any part of the conjunctiva is troublesome or likely to become so, it may be cut out or otherwise removed without hesitation. Small particles of grit or cinder often lodge on the inner surface of the upper lid, generally near its middle and about two or three millimetres from the free border. In this situation only eversion of the upper lid will

reveal the offending particle—a manœuvre very easily acquired by any one who will take the trouble to learn, but too often sadly bungled by inexperienced hands. The upper retrotarsal fold will occasionally conceal a foreign body from view, even when the eyelid is thoroughly everted, so that an examination of the conjunctiva exposed in this way may not suffice to establish the diagnosis. A foreign body lodged in the conjunctival *cul-de-sac* will sooner or later set up a traumatic conjunctivitis, and when of a penetrating kind, such as small spears of hay or straw, barley-beards, bits of twig, etc., the cause of the conjunctivitis will often be overlooked, especially if nothing be found when the lids are everted. If there is reason to suspect a foreign body thus concealed from view beneath the upper lid, the everted lid should be swabbed with a strong solution of cocaine, and in a few minutes the posterior edge of the everted tarsus may be grasped longitudinally between the blades of an ordinary pair of fixing forceps, and a second eversion performed by rolling the lid again upon itself, thus exposing the depth of the *cul-de-sac*. This may bring the foreign body itself into view or reveal a sprouting granulation which overlies the body imbedded in the subconjunctival tissue. A single mass of fleshy granulations in this situation with a chronic monocular conjunctivitis is almost pathognomonic of an imbedded foreign body: knowing thus its situation, the removal is easily accomplished with a fine pair of forceps, unless, as occasionally happens, the foreign substance happens to be of large size. (See Injuries of the Orbit.) The writer has frequently discovered in this way concealed foreign bodies which have been overlooked for months, the resultant conjunctivitis having been fruitlessly treated with all sorts of washes and eye-waters until the true source of the difficulty was discovered by the method of examination just described. The foreign substance then being removed, Nature, unimpeded, speedily completed the cure.

Injuries of the Eyeball.

Contusions of the Eye, followed by ecchymosis of the lids and subconjunctiva, may present an alarming appearance, but are not of much importance unless there be evidence of injury to the deeper structures of the eyeball, such as rupture of the cornea or sclerotic, effusion of blood into the anterior chamber or into the vitreous humor, dislocation of the lens, or perhaps injury of the choroid or retina. Whenever the contusion is followed by considerable impairment of vision, the prognosis must be guarded, and will depend upon the extent and severity of the actual lesions, some of which may not at first be discoverable; but in the simple contusions not attended with impaired vision there is little to fear, and the treatment will consist in the application of cooling lotions with rest of the eye for a few days.

Injuries of the cornea are met with in infinite variety. Simple contusions and abrasions may require soothing applications, and perhaps a compressive bandage until the surface is healed. The common practice of prescribing astringent lotions is to be avoided unless there is conjunctivitis with mucous or muco-purulent secretion, and even then if the eye is painful or irritable care should be taken not to use remedies that will increase the irritation. In solution of boric acid we have a remedy at once cleansing and soothing, especially adapted to this class of cases: it may sometimes be advantageously combined with sulphate of atropine if the irritation be sufficient to warrant the employment of the latter drug. Very slight injuries of the cornea may, especially in elderly people, be the starting-point of a destructive suppurative keratitis, the early signs of which will be an increasing opacity of the cornea at the seat of injury, pronounced inflammatory reaction, and perhaps a purulent deposit in the anterior chamber (hypopion). Many eyes have been lost in this way from trivial injuries.

Contusions of the eye often cause more or less interlocular hæmorrhage, which may come from rupture of certain blood-vessels in the iris or ciliary processes, choroid, or retina. A small quantity of blood may be extravasated on the iris or in the anterior chamber, or the chamber may be more or less filled with blood. When this clears away, as it will probably do in a few hours or days, the iris may be found torn at the pupillary margin, or, what is more common, it may be partially detached at the periphery (irido-dialysis). If there is no other lesion present, the eye will probably recover perfect or nearly perfect vision; sometimes, however, the pupil will remain more or less dilated and perhaps irregular, and there may be a persistent paralysis of accommodation. Any peripheral detachment will persist as a sort of artificial (marginal) pupil. Occasionally a partial or complete retrocession of the iris will be found to have occurred (traumatic iridræmia). Extravasation into the vitreous, if at all abundant, absorbs slowly, and may cause great or complete loss of vision. It can only be determined with certainty when the aqueous humor and lens are transparent, and then appears as dark floating clouds in the vitreous chamber, or the whole vitreous may be so darkened that the ophthalmoscope gives none of the normal red reflex from the fundus. With a wide pupil, when the anterior refractive media are clear, blood in the anterior part of the vitreous may often be seen by focal illumination, appearing as a blood-red streak or mass behind the lens.

Rupture of the Choroid by counter-shock is discovered immediately by the ophthalmoscope if there be not too much blood in front of it, or it may become visible only when an intervening blood-extravasation becomes absorbed. The same is true of traumatic detachment of the

retina. The lens may be found dislocated or opaque either immediately after the injury or when blood-effusion has cleared away. The prognosis in these cases of intraocular lesion from contusion will depend upon the extent and character of discoverable lesions. Instillations of atropine, cold compresses upon the lids, and rest of the eyes are the chief means of treatment. It is seldom good practice to draw off effused blood from the anterior chamber by paracentesis. The internal administration of drugs is of doubtful efficacy in promoting absorption of effused blood from the interior of the eye. A word here as to the mode of applying cold compresses: this should be done by means of thin pads of sublimated or borated absorbent cotton saturated with cold or iced water, and changed often enough to make the cold applications constant. No form of bandage should be used to keep them in place; a recumbent or semi-recumbent posture will suffice for this. The comfort of the patient is the best guide to the frequency of change and persistence in their use.

Ruptures of the Sclerotic, when extensive and associated with total abolition of vision, are best treated by immediate enucleation or evisceration. If personal appearance is a matter of great importance, the artificial vitreous of Mules may be inserted into the emptied sclerotic or within the capsule of Tenon after removal of the sclerotic. Otherwise, simple enucleation is to be performed. In ruptures of limited extent, running as they generally do through the ciliary region parallel to the corneal limbus, if there be good perception of light an attempt may be made to save the eyeball, bearing in mind, however, the great danger of sympathetic ophthalmia. These ruptures of the sclerotic are generally above the upper corneal margin, because the force of the blow is nearly always from below upward, and the globe gives way at an opposite point where the tension is greatest—counter-shock. Sometimes the lens will be found extruded beneath the unruptured conjunctiva, appearing thus as a smooth, rounded, semi-translucent prominence upon the sclerotic. If it has been decided not to sacrifice the eyeball, the lens may be removed without difficulty after the scleral wound has healed.

A sharp blow upon the eye, as from the cork of a soda-water bottle, is liable to cause rupture of the choroid by counter-shock in the vicinity of the optic nerve, usually in a curvilinear form between the optic nerve and macula lutea. More or less blood is extravasated at the seat of injury, the yellowish curvilinear rupture itself only coming into view later when this blood has been absorbed. There may be no other lesion discoverable. Vision is apt to be considerably impaired, and its recovery is seldom complete, probably because the retina is also damaged. The only treatment of this condition likely to be of service is complete rest of the eye.

Detachment of the retina is not an uncommon sequence of contusions or blows upon the eye. This disaster has been known to follow apparently trivial injuries. The detachment may occur immediately or in connection with reparative processes incident to other intraocular lesions. The symptoms of traumatic detachment of the retina do not materially differ from those of the more frequent spontaneous form. The treatment is equally unsatisfactory. Similar injuries may also occasion intraocular hæmorrhage, which, as already mentioned, may be into the anterior chamber or into the vitreous: when in the latter situation it may come from either the retinal or choroidal vessels. Blood-extravasations into the vitreous absorb slowly; when abundant there will of course be a long period of impaired vision, during which the prognosis must remain doubtful, as there are no means of estimating positively the nature and extent of the intraocular lesion so long as the fundus cannot be explored by means of the ophthalmoscope. There is little to be done for hæmorrhage into the vitreous: possibly, however, the administration of iodide of potassium internally and wearing a compressive bandage at night may accelerate the process of absorption.

Traumatic cataract always ensues when the lens capsule has been ruptured, so that the aqueous humor finds its way directly into the lens substance. It is probable, too, that a traumatic cataract may sometimes be produced by concussion of the lens without lesion of the capsule. Produced in this way, a cataract will not differ materially from the spontaneous form in relation to the general condition of the eye, unless the lens at the same time happens to be dislocated. When the lens capsule has been ruptured, either with or without a penetrating wound of the globe, a new element is introduced, inasmuch as the imbibition of aqueous humor causes it to swell and act as a foreign body within the eye. With a penetrating wound there is an additional element of danger in the fact that septic material may have been introduced with the penetrating substance or subsequently find its way in through the wound. A traumatic cataract rarely fails to become complete within a few hours or days, although it is not uncommon for a small foreign body to lodge in or pass through the lens and cause only a localized opacity. Sometimes we meet with traumatic cataracts undergoing spontaneous resolution; that is, being gradually absorbed without treatment as the lens substance becomes softened by soaking in the aqueous humor. So favorable a course of events is somewhat exceptional; and indeed the great majority of traumatic cataracts will result in destruction of vision if not properly managed. In the case of septic wounds, and especially in persons of deficient reparative power, a suppurative process may very soon set in and run a rapidly destructive course; as a general thing, however, symptoms of irritation

only slowly develop, in young subjects perhaps not until the lens has become so softened that it may readily be more or less completely removed by some simple operative procedure. A greatly swollen lens, or in elderly people even a moderate degree of swelling, is apt to involve a glaucomatous condition, for the relief of which an operation becomes imperative. Other things being equal, the younger the subject the more likely is a traumatic cataract to run a favorable course. In complicated cases, however, with a septic condition of the wound from the outset, it will often be found impossible to save the eye from destructive inflammation, either in the form of an acute panophthalmitis or an inveterate plastic or purulent irido-cyclitis.

Foreign Bodies on the cornea are often so small as to require the use of focal illumination and a magnifying-glass for their detection, or they may be large enough to be seen by the naked eye. Small particles of cinder, metal, or emery are most common. The discomfort they occasion is usually located by the patient beneath the upper eyelid. A careful scrutiny of the cornea will, however, prevent any mistake as to the real situation of the offending substance. Immediate temporary relief is obtained by instillation of a 2 per cent. solution of cocaine, and before its effects pass off there is no difficulty in removing such a foreign body without pain or further injury to the eye. This should be done under good illumination by means of a strong convex lens in the hands of an assistant, who holds the lens in such a position as to concentrate the light of a lamp upon the part of the cornea where the foreign body rests. In my own practice, thanks to the beneficent action of cocaine, I generally allow the patient to illuminate his own cornea by means of a biconvex lens four inches in diameter and of six inches focal distance. Standing behind the patient, who is seated in an ordinary chair with his head supported by the operator's body, the lids are separated with the middle and ring fingers of the left hand, whilst a convex lens of three inches focus is held between thumb and forefinger in such a way as to get an enlarged view of the cornea, which is to be illuminated by an assistant or by the patient himself holding the large glass at such a distance in front of the eye as to secure the maximum of illumination by the light passing through it from the lamp situated in front. An eye-spud or any similar instrument will suffice to lift away particles merely resting upon the corneal surface, but when at all imbedded a small lance-shaped needle with point curved upon the flat should be used. With proper illumination and the use of the operator's magnifying-glass undue scratching or laceration of the corneal surface can be entirely avoided whenever it is necessary to use the needle. When the foreign body has been removed, some white vaseline put into the eye, with a compressive bandage applied for a few hours, will be found soothing, and a speedy restoration of the denuded sur-

face generally ensues. Atropine and other soothing measures may be required if the eye is found to be irritable the next day. If after the foreign body is removed a small annular stain remains, it may be left to wear away rather than inflict further injury by attempting to scrape it off. Inexperienced persons sometimes mistake small dark pigment spots, so frequently found upon the normal iris, for foreign bodies on the cornea—an error which is easily avoided by observing that such spots lie in a plane considerably deeper than the corneal surface. Foreign bodies imbedded in the cornea, if large enough, may sometimes be grasped with a fine forceps and lifted away, otherwise the use of a cutting needle may be required for their removal. Occasionally a foreign body will be found projecting through into the anterior chamber, so that the attempt to remove the fragment thus situated might cause it to fall into the chamber and thus become lost to view. This accident can be avoided as follows: The eye being cocainized, place the patient in a recumbent posture, separating the lids with the speculum and steadying the eyeball with fixing forceps; a broad needle may now be made to transfix the cornea immediately behind the foreign body, which will then rest upon the blade of the needle, whence it may be easily and safely removed by means of a fine cutting needle.

Wounds of the Cornea.—Clean-cut, non-penetrating wounds of the cornea call for a thorough cleansing of the conjunctival sac with some mild antiseptic wash, after which a compress bandage may be applied in the usual way. Such wounds heal promptly in nearly every instance. Penetrating wounds of the same kind require a similar treatment, unless there be prolapse of the iris. The latter complication may occur in quite small wounds, situated near the corneal margin. Prolapse of iris, whenever present, requires special attention: its importance is apparently seldom recognized by persons not thoroughly familiar with ophthalmic surgery. Sometimes a quite recent prolapse may be replaced by friction suitably employed through the eyelids, or, failing in this, it may occasionally be pressed back into the anterior chamber with a fine spatula or curette. When once restored it may be retained in place by a frequent instillation of a solution of eserine, 2 grains to the ounce, and the application of a compress bandage: should, however, the attempt to replace and retain the prolapse not succeed (and it never can succeed when the prolapse of the iris has become glued to the edges of the wound by the effusion of plastic lymph), the prolapse should be seized with a pair of iridectomy forceps and gently drawn out from the wound as far as may be without tearing it, and cut off with a small pair of bent scissors the blades of which are pressed close down to the cornea and held parallel with the wound. This will convert the prolapse into an iridectomy. Sometimes a prolapse will be

found covered with lymph, which may either first be picked off with the forceps, or the lymph and iris together may be grasped and cut away as described. An expert operator may, if necessary, in some cases introduce the blade of the forceps within the wound, and so get a better hold of the portion of iris to be excised. Any attempt of this kind demands the greatest caution, as there is danger of wounding the crystalline lens, which, with an empty anterior chamber, of course lies in contact with the posterior surface of the cornea. The after-treatment will be that of an ordinary iridectomy. The earlier an operation for the relief of a prolapse of iris is performed the more likely it is to be successful. At the end of a week or ten days after an injury of this kind the operation as described above will hardly be practicable, but if a large prolapse has been left to itself, and threatens later on to develop into a staphyloma, an iridectomy may be performed on one side of the seat of injury. Should the surgeon succeed in reducing the prolapse of the pupillary border of the iris through a small wound situated near the centre of the cornea, atropine might be used to keep the dilated pupil away from the wound. A similar wound near the margin of the cornea would of course be an indication for the use of eserine. Atropine, like all other valuable remedies, is apt to be used unnecessarily: some practitioners resort to it for every trivial injury of the eye, whereas it should only be used after injury when there is some special indication for keeping the pupil dilated, as in traumatic cataract or when there is sufficient irritation or inflammation to demand the use of a soothing remedy of this class. It must not be forgotten that a single drop of a 1 per cent. solution of atropine will cause an annoying dimness of vision for a week or ten days, and will often greatly alarm a timid patient. In elderly people, too, atropine will sometimes bring on a troublesome conjunctivitis with "atropine eczema" of the lids, and when there happens to be a tendency to glaucoma an attack of this formidable disease may be precipitated by the injudicious use of atropine. If there is injury of the crystalline lens (*traumatic cataract*) this affords an additional reason for dealing promptly and efficiently with prolapse of the iris.

Wounds through the Sclero-corneal Junction, with prolapse of the iris and perhaps a part of the ciliary body, with or without escape of vitreous, should be treated in the same way. There ought to be no hesitation about cutting away all the prolapsed structures; sometimes a considerable mass of iris and ciliary body may thus require removal, in which case there will also be more or less of vitreous. Under these circumstances the strictest antiseptic precautions are essential. The wound if gaping may be united, after it has been properly prepared, with one or more fine silk sutures. In the scleral portion these need not go through the sclerotic, because with a very sharp curved needle

a sufficient hold may be secured in the subconjunctival tissue, and in the corneal portion too it is not necessary to go through its whole thickness. It is best to have two needles upon each thread, so that they may both be passed from within outward. Needles used for this purpose cannot be too sharp. Even very large wounds in this situation often do surprisingly well when carefully managed.

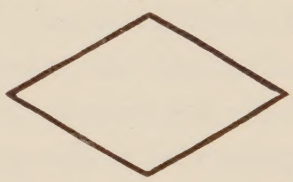
Wounds situated farther back, passing through the conjunctiva and sclerotic only, should be thoroughly cleansed and treated in a similar manner, but it will not always be necessary to unite the sclera with stitches when the scleral wound is small, though the conjunctiva should always be brought together over the wound in the sclera. Large scleral wounds are best united as directed in the foregoing paragraph. Thorough antisepsis throughout the healing process is *de rigueur*, especially as a compress bandage must be worn until the wound is united. It is quite generally conceded, though recently denied by some ophthalmic surgeons, that wounds involving the ciliary region to any considerable extent are especially liable to be followed by sympathetic ophthalmia; and this part of the eye has received the ominous name of "dangerous zone." Antiseptic surgery has, however, certainly done much to diminish the supposed danger of wounds in this region, and as a consequence the early enucleation practised in many of these cases need, I think, seldom be resorted to. In childhood, particularly, enucleation of the injured eyeball is commonly practised whenever the danger of sympathetic ophthalmia seems to threaten. But it is in childhood, of all periods, that a resort to enucleation must be looked upon as a calamity which should, if possible, be avoided. Although freely admitting that the occurrence of sympathetic ophthalmia would be a still great misfortune, the writer has reason to believe that even a lost and shrinking eye may often be retained without incurring additional risk. After an injury there is always an interval of two or three weeks before the other eye is liable to become affected through so-called sympathy. This interval is probably prolonged where antiseptic treatment is strictly followed, so that there is ample time for the repair of the original wound; this should be accomplished in the manner already outlined. At the end of about two weeks the wound may have healed without the occurrence of any unfavorable symptom, recovery being perfect as far as freedom from danger to the other eye is concerned, in which case the object of treatment has been attained; if, however, vision be destroyed or nearly so, and the eye not only shows signs of shrinking, but the seat of injury becomes retracted, the eye irritable and perhaps tender to the touch, the iris discolored and retracted at its periphery—or, in other words, as soon as a characteristic irido-cyclitis has developed—one of two courses is open: either the eyeball may be removed, or, instead of this, the optic nerve may be resected. Of late years the

writer has repeatedly chosen the latter operation in preference to performing enucleation where sympathetic ophthalmia was obviously threatened.

The operation of resection is performed as follows: The eye and all surrounding parts having been made thoroughly aseptic, and also the hands of the operator and assistants as well as all instruments used, the patient is to be etherized; then either the internal or external rectus muscle is freely separated from its attachment to the globe, and a pair of curved excision scissors is passed deeply into the wound well behind the eyeball, which is rotated strongly in the opposite direction, and the optic nerve divided about half an inch behind the eyeball. The globe may now be readily turned with a fine double hook or even with ordinary fixing forceps far enough to expose the optic nerve, which may now be cut off close to the eye and the severed piece removed. The parts behind the eyeball are then to be washed for several minutes, by means of a suitable canula syringe, with a solution of corrosive sublimate, 1 to 2000. When all bleeding has ceased the detached muscle is picked up with the double hook and its tendon reunited with three fine black silk sutures—one at the centre of the cut extremity of tendon, the other two about four millimetres on either side of this. Before the stitches are fastened a very fine piece of sterilized rubber tubing should be passed in far enough to reach behind the eye and allowed to project a short distance below the lower suture. A small quantity of corrosive sublimate may be injected behind the eye daily through this tube for a few days after the operation. For the first six hours a moist antiseptic dressing is to be pretty firmly applied with a compressive bandage; afterward cold antiseptic compresses, changed as often as may be necessary, will constitute the treatment until the wound is healed. On the fifth or sixth day the stitches may be removed from the tendon. The reaction following this operation has, in the writer's experience, generally been very slight. Those who believe in any other than the bacterial origin of sympathetic ophthalmia will of course deny that this plan of treatment gives as efficient protection against sympathetic mischief as enucleation. So far as a somewhat limited experience goes, the writer is strongly in favor of this method of treating threatening cases before the actual outbreak of sympathetic ophthalmia. Among some seven or eight cases treated substantially in this way there were no failures, and in every instance there is nothing further to record than the most gratifying results. As a preventive measure there seems no reason to believe that it is less efficacious than enucleation. On the patient it bestows the inestimable boon of retaining an eye which may ultimately look almost as well as its associate, and even when shrunken and disfigured permits of an artificial eye being worn which is much more natural in appearance and movements than when enucleation has

been performed. In childhood the advantage of this operation is infinitely greater, for by it the natural development of the orbit and conjunctival sac is secured and the unfortunate one thus protected from a hopeless, permanent, and irremediable mutilation. The scope of this article will not permit fuller discussion of this interesting subject, as we have here to deal with the management of recent injuries and not with their more remote effects, such as an actual outbreak of sympathetic ophthalmia. But if what has been said should contribute to the prevention of wholesale and unnecessary mutilations still in vogue, the purpose of these remarks will have been accomplished.

Laceration of the Eyeball.—When the eyeball has been so crushed and mangled that vision is immediately and entirely destroyed, a simple evisceration of the globe may be performed at once, or if the proper appliances are at hand the eviscerated sclerotic may be filled with one of Mules' glass globes. This ingenious and useful procedure, owing to certain imperfections in the details of the operation, appears to have fallen somewhat into disuse, but if performed in the manner described by Dr. John Morgan of Springfield, Mass.,[1] it will probably succeed much more uniformly than heretofore. Morgan reports six cases, all successful, in which he has performed Mules' operation. Instead of leaving a nearly circular opening, such as will be the case when the cornea only is excised, he says: "The opening was enlarged horizontally by removing two triangular pieces of the conjunctiva and sclerotic, thus changing a nearly circular opening to one represented by the following diagram in all but the first case. In the second case the pieces cut out were about two lines wide at the base and five in length; in the remaining cases two lines wide at the base and five long. The hæmorrhage continued about one hour and a half, and the artificial vitreous humor was not introduced until it had completely ceased. A solution of corrosive sublimate (1 : 5000) was used as an antiseptic in the first case; a hot saturated solution of boric acid in the second, third, and fourth; and hot water in the fifth and sixth cases. Some experienced no pain and ate and slept regularly, while others had so little pain or discomfort as not to interfere materially with eating or sleeping. The wound was closed in all but the first case with six sutures of fine silk—one through the conjunctiva on either side and four through the conjunctiva and sclerotic in the centre: constitutional disturbance too slight to report." The writer operated in a similar manner five years ago on an eye torn across by a blow from a stick; the result was perfectly satisfactory, and the boy, now a young man, is wearing an artificial eye so normal in appearance and movement as to challenge detection except by the closest observation.



[1] *Archives of Ophthalmology*, vol. xx., No. 1, p. 32.

Penetrating Wounds of the eye involving the crystalline lens give rise to traumatic cataract. The lens rarely fails to become completely opaque in a short time when its capsule has been ruptured, although in case of penetration by a very small foreign body a localized opacity may be all that occurs. Traumatic cataract presents two dangers. The first and most constant of these is due to the swelling of the lens and consequent pressure upon adjacent parts, thus setting up irritation which is liable to cause both increased tension and inflammation. The same may happen in non-penetrating as well as in penetrating wounds. In the latter we have also the second element of danger—namely, septic inflammation—either from the septic character of the penetrating object or from subsequent contamination of the wound by unhealthy secretions or unsanitary surroundings.

TREATMENT.—When there is prolapse of the iris this should be dealt with in the manner already stated. Strict antisepsis, cold compresses, and atropine instillation will generally suffice to keep inflammatory reaction in abeyance. The atropine (1 per cent. solution instilled several times daily) is imperative in order to keep the pupil dilated as much as possible, and so relieve the iris from the pressure of the swollen lens. If in spite of these precautions the eye become glaucomatous, in which case there will be increased pain and notable increase of tension, iridectomy must be performed, and if the lens be sufficiently softened, as much of it as will readily come away may be encouraged to escape through the wound. For this purpose gentle manipulation of the cornea with a smooth curette or spatula is allowable, and the point of the curette may be introduced a short distance into the anterior chamber if necessary, at the same time making gentle pressure on the posterior lip of the wound. After such an operation cold antiseptic compresses and atropine are to be vigorously employed until reaction subsides. If during the treatment of traumatic cataract any purulent exudation should make its appearance, either in the cornea or anterior chamber, cold applications are no longer admissible; they must be exchanged for hot fomentations, with solution of bichloride of mercury (1 : 5000 or 1 : 10,000) applied for fifteen or twenty minutes at least four times daily. In neglected cases, with extensive adhesions between the iris and swollen lens, an iridectomy with partial removal of the lens may prevent total loss of the eye, but, unfortunately, these cases often fail to obtain proper treatment until too late for successful interference. In many others a hopelessly septic condition of the wound and interior of the eye may from the outset render recovery impossible. The surgeon's task will then be to relieve pain and advise suitable measures for the prevention of sympathetic ophthalmia.

Foreign Bodies within the eye present a form of injury which is

always dangerous to the integrity of vision and often extremely difficult to deal with. The first question to be decided is whether the penetrating substance has really lodged within the eye. This may sometimes be decided by simple inspection or with the aid of focal illumination or the ophthalmoscopic mirror. The latter is most useful as a means of examination when the foreign body has passed into the vitreous chamber; the former when the foreign substance is anterior to this, as in the anterior chamber, iris, or lens. It is said that a drop of water pushed by the lower lid over the lower edge of the cornea will sometimes bring into view a foreign body lying concealed in the lower periphery of the anterior chamber. When the foreign body cannot actually be seen by any of these methods of examination, the history of the injury is to be taken carefully into account: the size, shape, and position of the external injury, as well as the condition of vision and the state of the internal structures of the eye, are to be studied minutely. By far the largest number of these injuries are met with among metal-workers and stone-breakers. Small particles striking the eye with great velocity often make almost imperceptible wounds in the sclera or cornea. Hæmorrhage into the vitreous with a very small scleral wound or scar almost certainly indicates a foreign body within the eye. So too will a small, fresh wound or scar in the cornea, with a corresponding aperture in the iris with or without a traumatic cataract, partial or complete, unless the injury can be proved to have been produced by some long, thin, pointed object, such as a pin or needle, which may have been withdrawn at the time of injury. When a small fragment of steel from a workman's tool penetrates the cornea or sclerotic, the chances are strongly in favor of its having remained in the eye, as there is only one way in which it could have escaped; that is, by passing through the eyeball into the orbit. This may happen with larger fragments quite readily, in which case the eye is apt to be badly torn and filled with effused blood, vision being totally destroyed; but small fragments will only pass through and through the eyeball when projected with unusual velocity, as when the blow is struck with a two-handed sledge and the injured eye is quite near the projecting force. Small fragments detached by a one-handed blow are likely to penetrate the eye and remain in its interior. Small pellets of lead, such as ordinary bird-shot, generally pass through the eye if the wound is inflicted at a distance well within the range of the gun; but when the distance is so great that the shot is nearly spent, the projectile will probably be lodged within the eye. It will be observed that although the attending circumstances of the injury may lend a strong probability as to the position of a penetrating but concealed foreign body, certainty may be unattainable. Probing the track of the wound will very rarely reveal the position of the foreign body, and should

never be attempted unless the missile has evidently been of considerable size, in which case the eye is probably already so much damaged that a carefully conducted search will do no further harm. The point of an electro-magnet introduced a short distance within the wound will sometimes find the concealed foreign body if it consists of iron or steel, but it is only when the exact position of the fragment of iron can be otherwise determined that the electro-magnet may be fully relied upon as the means of extracting it: then an incision may be made through the sclerotic in a suitable position and the tip of the magnet introduced to a point so near the fragment that it will be attracted. The electro-magnet has achieved some remarkable successes in removing bits of steel from the vitreous, and when there is a reasonable certainty that the vitreous chamber contains a fragment of this kind, though invisible, an attempt may be made to extract it with this instrument, as it offers the best chance of saving the eye from destructive inflammation. If a fresh wound requires to be made for the introduction of the magnet, the point to be preferred is behind the ciliary region, midway between the external and inferior recti muscles. It should be 6 to 8 millimetres in length and have a meridional direction. The patient, if timorous, should be etherized. The most scrupulous antisepsis is necessary. The larger magnet-points in use have the greatest attractive power, and are therefore to be preferred. One of these, perfectly sterilized, may be gently introduced through the wound in the supposed direction of the foreign body; then, the circuit being closed, the point is slowly withdrawn, turning its flattened surface edgewise between the lips of the wound. If unsuccessful, it may be reintroduced one or more times in different directions, always taking care to avoid lateral movements of the point whilst in the vitreous. Groping thus in the dark, there is no certainty of finding the fragment, or when reached of disentangling it even when touched by the magnet. If the attempt fails, the eye may be enucleated or eviscerated immediately, or the wound may be closed and an attempt made to keep inflammatory action in check with a view to subsequent enucleation of the eye or resection of the optic nerve. Immediate enucleation or evisceration of the globe is justifiable when the eye has been greatly and irreparably damaged, apart from any further injury inflicted by an unsuccessful attempt to remove the foreign body; but when the foreign body is obviously a small one or at all likely to have been driven through into the orbital space, an expectant course may be pursued. If the operation proves successful, the eye should be dressed antiseptically and kept perfectly quiet for several days. Further treatment will depend upon the amount and character of the inflammatory reaction. If a persistent irido-cyclitis should ensue, it may become necessary to remove the eyeball or perform some

alternative operation in order to prevent a threatened sympathetic ophthalmia. No hard-and-fast rule can be formulated for the management of this class of cases, and after carefully weighing all the circumstances of any given case the surgeon will have to be guided largely by his own judgment. In a few instances small foreign bodies of a non-magnetizable nature have been extracted by incising the sclerotic in their vicinity and removing the fragment with a blunt hook or curette. A small foreign body in the anterior chamber when adhering to the iris may be removed by an incision at the corneal margin, such as is commonly made for iridectomy ; then the body itself may be grasped with a serrated iridectomy forceps or a portion of the iris including it may be withdrawn and excised. If the particle is of iron and very small, it might conveniently be withdrawn by the magnet without excising the iris. Stone- and metal-workers are very liable to injuries of the eye, which often deceive the inexperienced—first on account of the smallness of the external injury, and second because the patient is apt to be positive in his belief that nothing can be in the eye, because, he says, "if anything were in the eye I would feel it." A pardonable error indeed, but one which will not mislead if with the history of a slight injury there is found a small penetrating wound, dimness of vision, dark floating objects before the eye, and dark masses in the vitreous, which are readily seen with the ophthalmoscope (mirror illumination) when the pupil is dilated with atropine. In the presence of these signs a foreign body within the eye is almost a certainty. When a foreign body has penetrated the eye and probably rests in the interior, but cannot be discovered, the eye, as a rule, is practically lost. The position of the external wound is then absolutely no guide as to the precise location of the foreign substance, since the latter may have rebounded from the opposite wall of the eye and found its resting-place in any part of the interior, or it may have passed quite through the globe and lodged anywhere in the orbital tissues. In doubtful cases, without positive indications for interference, the surgeon will often do well to follow the expectant plan of treatment, watching the course of events and meeting symptoms as they arise. The use of cold compresses, atropine, and perfect rest of the eye will in some instances enable it to endure the intruder. If not, the proper time for active interference will come when the other eye seems to be seriously threatened. In any doubtful case the patient must be made to understand the constant peril he is in ; that the most vigilant watchfulness is absolutely necessary so long as the injured eye shows the least irritation ; and that a persistent deep-seated inflammation may at any time call for the removal of the injured eye. With an intelligent patient under constant observation a more conservative course may be pursued than where the conditions are the reverse of these.

Very small wounds of the lens, even when there is a foreign body imbedded in its substance, call for measures to check or to soothe irritation. The most efficient of these are rest in a dim light, with cold compresses constantly applied and changed as often as they become warm; atropine instillation or some equivalent form of mydriatic is indispensable. With this treatment the eye will, as a rule, become quiet, so that the cataract may be dealt with at leisure or left without further treatment. If, however, the lens becomes swollen, with symptoms of irritation, such as pericorneal injection, pain, and perhaps increased tension, it may be necessary to remove it within a week or two from the receipt of injury. In discussing prolapse of iris it has already been stated that a prolapse in the presence of a traumatic cataract should always be converted into an iridectomy with as little delay as possible. Supposing the lens to be so wounded that it becomes generally opaque within a few hours, the first thing to be done is to render the wound, as far as possible, aseptic. To this end the parts about the eye are to be thoroughly washed with soap and water and then with bichloride solution, 1 : 2000, the eye itself with a weaker solution of the same, say 1 : 5000, or a saturated solution of boric acid: with this the wound should be thoroughly syringed; some of the liquid, used tepid, may be cautiously introduced into the anterior chamber if the wound is still open. For this purpose a small instrument, such as Myers's lachrymal syringe, is convenient. No time should be lost in getting the pupil dilated with atropine, using a fresh clean solution of 1 per cent. from three to six times daily if necessary. When the chief object of using atropine is to dilate the pupil, it should not be instilled more frequently than may be necessary to maintain dilatation after it has been obtained. Once or twice daily will often suffice when dilatation has been secured; the condition of the pupil and the amount of irritation will in any case afford the necessary indications. Cold compresses, saturated with a solution of boric acid or of bichloride of mercury, 1 : 10,000, with perfect rest, will greatly aid in preventing or allaying undue reaction. Occasionally four to six leeches to the temple and the internal administration of aconite will be found beneficial if reaction be excessive and the pupil difficult to dilate. The longer the eye can be kept in a quiescent condition, the better chance there will be of ultimately removing the lens and restoring vision. The lens, even in young subjects, rarely becomes soft enough to admit of removal sooner than five or six days after the injury, and it is highly desirable that reaction be kept in check until the softening of the lens is sufficiently advanced, or in any case until the cataract is complete. If with the softening and swelling of the lens, which then often assumes a flocculent appearance, the pupil remains well dilated by atropine and symptoms of irritation subside, the process of absorption may be allowed

to go on undisturbed, unless for some special reason it is thought desirable to hasten the cure by removal of the lens. If the latter course is chosen, the softened lens may be removed by a linear incision about four millimetres in length made in a vertical direction with a broad needle or keratome, midway between the centre and outer margin of the cornea. Through such an incision a soft lens will readily escape when the lips of the wound are gently pressed apart with a silver curette. Remnants of the lens, not coming away readily, may be allowed to remain for absorption, in which case, as indeed where the extraction has apparently been complete, excessive reaction should be diligently combated by the free use of cold antiseptic compresses and frequent instillations of sterilized solution of atropine. If there is any doubt about the lens being thoroughly softened, as when symptoms of augmenting and uncontrollable irritation have forced the surgeon's hand—which is especially apt to be the case in elderly subjects—the incision should be the same as in the extraction of senile cataract, and it will generally be safer to perform the operation with iridectomy. The writer has found McKeown's method of washing out the anterior chamber most satisfactory in cases of this description, as it ensures a more complete removal of semi-opaque and cohesive lens substance. After this operation the energetic use of cold antiseptic compresses and atropine is indispensable. Antipyrine or phenacetin at night also aids in subduing excessive reaction. The patient should be kept in bed in a darkened room and on milk diet. The time-honored custom of freely administering cathartics during the course of inflammatory affections of the eye seems to have fallen into disuse, but it would be a mistake to fall into the opposite extreme, particularly at the outset of a traumatic inflammation. Whenever in traumatic cataract the external wound assumes a purulent aspect or if pus forms in the anterior chamber, cold applications are no longer admissible, and must be promptly replaced by hot fomentations of an antiseptic character. The prognosis under these circumstances is generally unfavorable, as operative interference is almost precluded for the time and the inflammation runs a protracted course, sometimes ending in panophthalmitis, or at best leaving a closed pupil, extensive adhesions, and other destructive changes in the anterior part of the eyeball. Fortunately, with careful treatment from the beginning traumatisms of the eye do not often give rise to purulent inflammation of the injured parts. A traumatic cataract caused by a small foreign body known to be imbedded in the lens is sometimes better left undisturbed, because there is no certainty of removing the particle with the lens, except when it consists of iron and the electro-magnet can be used. Otherwise, so long as the eye remains healthy in other respects and harmless, the safest course is to leave well enough alone.

Injuries of the Orbit.

Injuries of the orbit occur in great variety as to nature, extent, and complications.

One of the simplest forms of orbital injury may be caused by a moderate blow across the nose, with the usual epistaxis. Shortly afterward, on blowing the nose to clear it of blood-clots, a sudden swelling of the eyelids may appear, perhaps entirely closing the eyes; the swelling is soft, puffy, and crepitates under pressure of the finger. It is caused by air forced through some small fissure of the inner orbital wall, establishing a communication between the nasal and orbital cavities, with consequent emphysema of the latter. Such an accident, although presenting a somewhat alarming appearance, is unimportant; recovery takes place in a few days. Cooling lotions may be used whilst the swelling lasts, and the patient should be instructed to abstain from blowing the nose.

Contusions or wounds of the soft parts around the orbital margin constitute the ordinary lesion in so-called black eye; the integuments may be so sharply cut by sudden pressure between the weapon or missile and the orbital margin as to lead to the belief that a cutting instrument had been used. The deep surface of the skin is, however, evidently more widely cut than the superficial; moreover, swelling and reaction are greater than follow clean-cut wounds from the outside. Such wounds are apt to suppurate, hence the most careful antisepsis is essential both before and after the external wound is closed, for which purpose fine silk sutures should be used, and cold antiseptic dressings may be employed to keep down reaction. Should suppuration occur, prompt evacuation of the pus is indicated. For an ordinary black eye a weak cold alcohol lotion, so applied as to promote evaporation, will be found useful, and when swelling subsides the remaining disfigurement is best disguised by suitably painting the discolored integument. Only in very considerable subcutaneous effusion of blood are punctures with a sharp lancet admissible, and in this case antiseptic precautions must not be neglected.

Fracture of the orbital margin is a common sequence of violent blows upon this part. Injuries of this kind are always liable to serious consequences, because the orbital walls may be fissured and the adjacent structures involved. Injury to the brain, the optic, and other orbital nerves and to the structures in the cavernous sinus are well known to be frequently associated with fracture of the orbital walls. The blindness which often follows injuries of this kind is generally due to lesion of the optic nerve from fracture extending through the optic foramen, and not to commotion of the retina, as formerly supposed. Under these circumstances atrophy of the optic nerve soon follows,

and may perhaps be noticed so soon as swelling has subsided sufficiently to admit of an ophthalmoscopic examination. The loss of sight which attends this form of injury is likely to be permanent.

An injury of the head attended with fracture of the base may be followed by loss of vision of one or both eyes, without orbital symptoms at the time. In these cases the fracture will have extended across one or both optic foramina. The ocular symptoms are apt to be unnoticed for a time on account of the patient's general condition precluding an intelligent exercise of the senses. Even ophthalmoscopic signs of injury to the optic nerves may be absent for many days: sooner or later, however, evidence of inflammation of the nerves and adjoining retina will most likely appear, or simple atrophy of the nerves without inflammatory changes may ensue. Pulsating exophthalmos is another sequence of this form of injury, and is then due to fracture extending across the cavernous sinus, with injury of both artery and vein in this situation of such a kind as to establish a communication between them (arterio-venous aneurism).

Prolonged pressure upon, or ligation of, the corresponding common carotid has cured many of these cases. As illustrating another source of danger from injuries of this kind, the following case, which came under the writer's observation a few years ago, may be given: A young man twenty-two years of age was knocked down by a fragment of boiler iron from the explosion of a steam-jacket; the missile struck him over the left brow, making an indentation here about one inch in length and one third of an inch in depth; he was unconscious for half an hour, but able to be about again in the course of a week. Two weeks after the injury he noticed failure of vision of the left eye, and a few days later the eye was examined and found to have vision $= \frac{20}{70}$, with marked pallor of the optic nerve. Shortly after this he had two or three slight attacks of epistaxis, and about the end of the fifth week from date of injury a sudden profuse flow of blood from the nose occurred, ending fatally in a few minutes. A post-mortem examination showed a fissure extending across the orbital roof, optic foramen, sigmoid sinus, and body of the sphenoid bone, with ulceration of the carotid artery and the bone beneath it extending through into the superior meatus of the nose. The carotid artery had simply poured its contents into the nose.

The cerebral symptoms which follow direct injuries of the orbit—as, for example, when some pointed instrument or weapon has been thrust through the orbital roof—are immediate or remote, the former being due to injury of the brain substance or to intracranial hæmorrhage, the latter to subsequent inflammatory changes in the brain or its meninges.

More or less prolonged loss of consciousness, and sometimes collapse,

is said to occur in 25 per cent. of orbital fractures from direct violence. These symptoms would be of special importance where the external injury is apparently trivial. On the other hand, immediate signs of cerebral lesion are wanting in a large proportion of these injuries, tending to give both patient and physician a false sense of security, too often rudely disturbed by the sudden outbreak of dangerous or even fatal cerebral complications.

The period of latency varies greatly. One patient has shown no sign of brain lesion after the injury, but fallen dead after walking a quarter of a mile; another dies suddenly shortly after the removal of a foreign body which had remained inert in the orbit for forty days.[1]

The possible long period of latency which characterizes this class of injury should put the physician on his guard and cause him to devote the most minute attention to every available diagnostic point, not only in regard to the history of the injury, the position, extent, and peculiarities of the wound, but also in respect to even the slightest departure from the normal state of health. The cerebral symptoms which may arise in consequence of inflammatory changes in the brain or its meninges are variable in accordance with the extent and severity of the secondary lesions. Any one or more of the following may be present: viz. headache, vertigo, loss of memory, a feeling of prostration, paralysis of the extremities, delirium, loss of consciousness or coma; or there may be a slow pulse, vomiting, and optic neuritis. The three latter occurring several weeks after the injury would almost certainly indicate abscess of the brain. Whilst the former, taken in connection with the external lesion, may be strongly indicative of brain trouble, they are by no means conclusive as to its nature or extent.

Some idea of the prognosis of direct fractures of the orbital roof may be gathered from the statistics of 52 cases quoted in *Graefe-Sœmisch.*[2] Of these, 11, or 21 per cent., survived. Among this number 3 remained hemiplegic, 1 suffered permanently from headache in stooping, and 1 likewise from loss of memory. Of the remaining 41, or 79 per cent., fatal cases, 18 died from the immediate effects of the injury, and 18 from inflammatory affections of the brain or its membranes, and in 5 the cause of death was not stated.

It is a somewhat remarkable fact that direct fractures of the orbital margin and roof combined are relatively less fatal than when the orbital roof alone is fractured without implication of the margin. Of the former injury, in 19 cases only 3 were fatal. In this connection a case recorded by Berlin is typical of the tendency to recovery after severe injury of the margin and roof of the orbit: "A soldier fell from a fourth-story window, striking the right side of his face and head against the corner of a low wooden structure. The malar bone and

[1] *Graefe-Sœmisch Handb. d. Augenheilk.*, vol. vi. p. 603. [2] *Loc. cit.*

orbital margin corresponding to its frontal process and the adjacent portions of the frontal bone were fractured so badly that all these parts were quite loose and freely movable. After removing fragments of bone, among which was a large piece of the orbital roof, a considerable extent of lacerated brain could be plainly seen. This was thrown off and the wound healed. The patient recovered with a certain degree of mental hebetude and a slight paralysis of the left upper and lower extremities and of the sphincter vesicæ."

It is to be observed that injuries involving the orbital margin are in a better position to throw off exudation, injured tissue, and débris than the deeper-seated orbital fractures.

A case of abscess of the brain caused by injury of the orbit, described by H. D. Noyes,[1] illustrates the chronic courses which these injuries sometimes display, as well as the good results obtainable by judicious surgical interference: "In 1857 a boy ten years of age was brought into the New York Hospital after having been run over by a street-car. There was fracture of the occipital and frontal bones. The patient remained about three months in the institution. He recovered without paralysis or loss of any function, but was always subject to headaches and had a small fistulous opening at the upper and inner angle of the right orbit, just under the brow. In 1865, I saw him, and, noting the fistula, warned him that he was liable to have trouble from it. He lived a wild life and was sometimes drunk. In the latter part of 1865, I was sent for to see him, and found he had serious brain symptoms. Consciousness was not abolished, but almost gone; pulse slow, breathing heavy. He had had severe headache, and been in bed for several days. By the ophthalmoscope I could only see hyperæmia of both nerves. The usual discharge from the fistula had recently ceased. I concluded that there must be an abscess near this spot within the cranial cavity, and determined to trephine the skull just above the fistula. A large crucial incision was made, and I trephined just outside the supraorbital notch. The dura mater bulged into the wound: I opened it and pus escaped. About half an ounce issued, and I put my finger into the cavity over the roof of the orbit. The patient, who had sunk into coma during the consultation over his case, recovered intelligence at once, in half an hour was able to talk, and made a good recovery. He had fungous granulations (hernia cerebri) from the wound, but at length by a pad and pressure bandage and excision this was controlled, and he has never reported himself since."

Injury of the nasal duct from fracture extending through its bony walls would seem to be of rare occurrence, since it is difficult to find in literature any description of this condition. The writer has, on several occasions, met with obstructed and apparently obliterated

[1] *Diseases of the Eye*, 1890, p. 686.

nasal duct dating from an injury in which blunt force applied over the bridge of the nose had been followed by permanent depression of this part and evident displacement of the nasal process of the superior maxilla.

Such injuries give rise to a permanent and incurable obstruction of the nasal duct, due no doubt to a callous formation across its lumen. If seen early enough, this might perhaps be prevented by the insertion of a silver style until healing had been accomplished. A chronic dacryocystitis always accompanies this form of obstructed nasal duct, for the cure of which the operation of obliterating the lachrymal sac may be necessary.

A crushing blow upon the malar bone will sometimes produce a sort of dislocation, or rather an impacted fracture, of this bone, recognizable by the depression which is found where its orbital margin joins the superior maxilla, and perhaps also at the junction of its temporal process with the frontal bone. With this injury, too, the optic nerve may be injured by the blood-extravasation in the orbit or by the injury extending to the optic foramen.

A still more dangerous injury is where a hard, pointed weapon or instrument has been driven into the orbit and through some part of of its delicate bony walls has penetrated the cranial cavity. The external wound may be very small—almost undiscoverable, in fact—if it happens to occur between the lids and the eyeball. It is not safe to probe or explore deeply wounds of this kind with any instrument in a direction toward the cranial cavity ; only when the injury has been inflicted by a body of considerable size, yet short enough to lie concealed in the orbit, would an exploration be at all likely to prove beneficial. The safest instrument with which to explore punctured orbital wounds is the surgeon's little finger. The external wound might be enlarged somewhat to admit the finger if deemed necessary. Symptoms of brain disease following this class of injury, or in fact any injury that is likely to have caused fracture of the orbital walls, are to be narrowly watched for. Abscess situated in some part of the frontal lobe is not an uncommon result of these injuries, and when the brain symptoms are strongly indicative of its presence an exploratory operation will be in order. The records of surgery contain several successful operations for the relief of the brain-abscess following injuries of the orbit, and these will no doubt be largely increased when surgeons learn to overcome the traditional fear of interfering with the brain or its meninges.

Injuries of the Optic Nerve.

Wounds of the Optic Nerve are so rare that little need be said concerning them. Thrusts with sharp-pointed weapons have been

known to destroy the function of the nerve without materially injuring adjacent parts.

Gunshot wounds may destroy one or both of the nerves without much damage to adjacent parts, but in the case of bullet wounds of the orbit the size and direction of the bullet will help to determine the gravity of the lesion. If the cranial cavity is penetrated, a fatal issue may be expected. Sometimes a bullet may lodge in the orbit in such a position that it can readily be found and extracted. The writer has seen one case in which a rifle bullet passed transversely through both orbits, causing blindness of both eyes by injury of the optic nerves. Injuries of this kind will require to be treated on general principles. The surgeon should never allow mere curiosity to influence the management of such cases or add to the existing injury. Bullet wounds of the eyeball itself are of course nearly always fatal to vision. Hæmorrhage into the orbit is generally the result of injury, and is a common sequence of fracture of the orbital walls. When extensive there may be a marked ptosis; a small orbital hæmorrhage may only become known by the late appearance of ecchymosis creeping into the upper lid and ocular conjunctiva. This symptom is supposed to indicate fracture of the orbital roof. The treatment of orbital hæmorrhage consists in cold compresses, pressure bandage, and rest, and paying due regard to any complications which may be present. Foreign bodies in the orbit are often difficult to find if they have passed out of sight. Sometimes the entrance wound is not easy to discover, and even when obvious an exploration of the deeper parts may not be feasible, owing to the soft and elastic nature of the orbital contents closing the track of the wound. It will thus be seen that the presence of a foreign body in the orbit, even when of considerable size, cannot always be determined. A skin wound will be likely to close quickly, and thus effectually conceal the foreign body, but when the point of entrance has been through the conjunctiva, a small mass of sprouting granulations in the conjunctival cul-de-sac, with persistent conjunctivitis, may lead to discovery of the foreign body: with this symptom and a corroborative history an exploration from the suspicious point may be undertaken. It is needless to say that when a foreign body is discovered in the orbit it should be removed. If incisions are necessary, great care must be taken not to wound important structures in the vicinity.

Foreign Bodies in the Orbit.—Quite large foreign bodies, resting partly in the orbit and partly in adjacent cavities, have often been successfully removed. With penetration of the cranial cavity fatal brain lesions are likely to ensue either before or after removal of the foreign body.

In doubtful cases deep-seated orbital inflammation sometimes occurs (orbital abscess), and aids in establishing the diagnosis: under these

circumstances an early and free incision should be made into the inflamed tissues, in order to prevent further damage to the optic nerve and eyeball, etc. An exploration of the abscess may lead to the discovery and extraction of the foreign body.

Birdshot and other fragments of metal often remain in the orbit for an indefinite length of time, becoming encysted and harmless. The removal of such should never be attempted unless they can be readily and definitely located.

DISEASES OF THE EXTERNAL EAR AND TYMPANIC MEMBRANE.

By B. ALEXANDER RANDALL, M. D.

The external ear consists of the auricle and the external auditory canal, and is covered in all its parts by a continuation of the general integument of the body, subject to the cutaneous diseases which may occur elsewhere. The prominent surface of the mastoid posteriorly is in close anatomical and clinical relation with it; but as it is more frequently and seriously affected in connection with the middle ear, only its superficial lesions need be considered here. The skin-covering is supported for the most part by a framework of fibro-cartilage, which is developed from a series of nodules grouped around the second fœtal cleft of the embryo; and defects or variations in their development give rise to various congenital anomalies, such as microtia, polyotia, supernumerary appendages, aural fistula, atresia or absence of the canal, and numerous peculiarities of the form of the helix. These conditions may call for surgical intervention to remove deformities, or to secure an open auditory canal in cases in which the acoustic apparatus beyond the closure gives promise of useful and improved hearing through freer access of aërial vibrations. Such details need not further detain us.

DISEASES OF THE AURICLE.

The exposed position of the auricle upon the side of the head results in numerous forms of traumatism, among which may be included frost-bite and sunburn, as well as other thermal, chemical, and toxic involvements. Surgical intervention may be required to repair lacerations or the deformities resulting from them, and the general surgical principles of treating such inflammatory lesions are here also to be applied. The cysts of the ear, so called, are generally to be placed in the category of traumatisms, for while true cysts may form without involvement of the cartilage, and also cystic othæmatomata which

result from spontaneous chondromalacia, it remains probable that trauma plays a large part in precipitating their occurrence. The discharge of suspected attendants has more than once cut short an epidemic of othæmatomata among the insane. At the same time it has been experimentally shown that lesion of the restiform body is followed by such an affection on the corresponding side; and there is strong probability that some such lesion exists as a predisposing cause in all (whether insane or not) who so suffer, except after marked violence.

Perichondritis of the auricle may occur in more typical form, and at certain stages be readily distinguished from the true cyst, the spontaneous hæmatoma, or the traumatic lesion. It is apt to be an extension of a phlegmonous inflammation of the canal.

True cysts should be enucleated; the cystic collections generally call for early evacuation, if only to relieve pain and limit their extension. Pressure is the important part of the after-treatment, generally preceded by irrigation of the cavity and stimulation of its walls by scraping or iodine, and supplemented later by massage. Deformity is the usual result, but may sometimes be avoided under such measures.

Ulcers of the auricle may occur as the result of syphilis, tuberculosis, or malignant growth, more frequently from the indefinite malnutrition conveniently styled struma. Stimulation and protection locally and general supporting measures are indicated.

Eczema is the most common form of inflammation of the auricle and external canal, its chronic types being due to a dyscrasia such as gout. In its varied aspects in the acute form the diagnosis from the rarer herpes or from erysipelas is at times very difficult, and some cases may be regarded as combinations. Involvement of adjacent parts, especially of the cheek or the scalp, is frequent in eczema; the whole side of the head is more likely to be affected in erysipelas; while herpes is more limited, and the eruption may be preceded for several days by severe pain. Stupes of lead-water and laudanum are generally of marked benefit in the erysipelatous condition, with internal administration of tincture of chloride of iron: quinine is indicated in the herpetic, arsenic in the eczematous forms. Fissuring and crust-formation are generally marked in eczema of the auricle, and call for cleansing to the verge of meddlesome interference, the warm douche, and even poulticing, being advised by some authorities as aids to the removal of crusts. A strong prejudice against water in the treatment of eczema has prevented my using either means freely, and I have been fairly satisfied with the results of softening the secretions by oily applications, removing them by mopping and forceps, and protecting the surface with an ointment of calomel. Ichthyol and a host of other medicaments have shown no superiority over this simple application,

preceded in some cases where the exudate formed very freely by painting with a strong solution of nitrate of silver, which is also valuable in frost-bite.

Malignant tumors of the external ear are rare and little amenable to treatment. Surgical interference must be very complete not to be worse than useless, since epithelioma if undisturbed may be very slow and painless in its progress, while sarcoma generally terminates fatally within a year in spite of every effort to extirpate it. Fibroid or keloid tumors, almost always of the lobule, are rare except among negroes, and are apt to recur after removal.

Abscess of the lobule, which, like the keloid growth, is generally ascribable to the habit of piercing the ears for ear-rings, follows frequently upon the piercing with unclean instruments, a whole group of children simultaneously so treated sometimes presenting the same lesion. Irritation by rings of base metal may at times be responsible, or laceration from dragging upon them may be followed by suppurative inflammation. The general surgical treatment by evacuation, irrigation, drainage by a clean thread, and pressure and protection by a bandage is to be carefully carried out, so as to leave the least possible tendency to recurrence or keloid scarring.

DISEASES OF THE AUDITORY CANAL.

THOROUGH inspection is essential in the study of the deeper parts of the ear, and is best accomplished with the aid of the concave forehead mirror, which throws a concentrated beam of light in the line of the observer's sight. Individual choice places the mirror above, below, or to the side of the eye, but the position with the eye at the central sight-hole is optically far superior, and a generous opening in a mirror fitting close in under the brow (made easy by a double ball-and-socket joint) leaves binocular vision unhampered. With good central illumination a speculum is often needless, and its routine use before careful examination without it is to be condemned. When direct light falling into the ear is used instead of reflected light, the speculum becomes more necessary, and in many cases it serves to press aside obstructing hairs, distend a collapsing canal, or bring into full view some portion not seen with satisfaction without it. As the auditory canal is almost always oval in section, the specula for use within it should generally be oval, although the conical instrument of Wilde makes the best dilator where swollen tissues have to be pressed aside. Thorough cleansing should always follow its use, whether we regard the case as infectious or not, and boiling affords the best and safest means. For

this reason metal specula are to be preferred to the light and convenient hard-rubber instruments. Aluminium promises to be the best material.

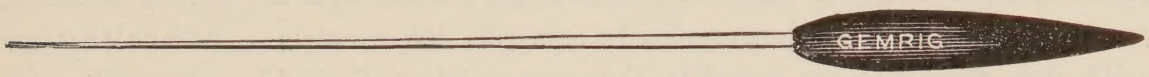
The auditory canal is usually directed slightly upward and forward as it passes inward, and the auricle hangs a little lower; so the helix is to be drawn out, up, and back as the first step in inspection. This is best done by grasping it between the index and middle fingers, the tip of the former remaining free to aid the thumb in managing the speculum if one is used. If the instrument is found necessary, it should be very gently inserted under full illumination and with the canal straightened by traction, its oval corresponding with that of the canal, as with a slight rotary motion it is guided rather than pressed into place. The view through it is usually limited, but the remedy lies not in trying to force it deeper, but in directing it to various portions of the fundus in turn.

Complete study should be made at the first examination, if possible, of every portion of the auditory canal and the drumhead—a study calling for the removal of every tiny crust or scale which might conceal a lesion. Important findings often reward the investigation of apparently trivial abnormalities; and this is perhaps most frequent at the upper anterior part of the membrane, the margin most difficult to see if the fashion of wearing the mirror above the eye be adopted. Here a brown, cerumen-like scale will often be found, and its removal will reveal above the short process a red moist point or an open perforation. The disputed claim that a congenital "foramen Rivini" is here present may never reach a settlement; but embryologist, anatomist, and clinician agree that it is normally absent, however common. It is rare in early childhood, common in later life, and it is safe to assume that it is a pathological perforation telling of a former, if not a present, outburst of secretion from the upper portion or attic of the tympanum. Walb urges that it serves as a channel for infection from without, giving rise to serious consequences, which will be dealt with in a later section—a view emphasizing the need of cleansing in this locality.

Minute care is needed in the inspection of the depths of the canal, for the lesions and alterations are often very inconspicuous; but a small series of careful observations, well correlated with the facts of normal and pathological anatomy, will soon qualify the painstaking student for rapid and accurate diagnosis in the majority of cases. Delicate use of the light cotton-carrier will be often needed to remove obstructions and as a probe to aid sight by touch. The normal anatomy, especially in relation to the oblique position of the drum-membrane, which can hardly be realized in the clinical picture, must be repeatedly forced upon the attention; and the combined use of eye and hand will do much to secure this result. As a schooling in the delicacy of manip-

ulation which these cases often require, such investigation has great practical value; for the most punctilious cleansing is often therapeutically necessary, yet can be accomplished only by skilful and persistent use of probe, curette, and forceps, as well as the more haphazard syringe. Much of the minutia of this work belongs to the trained specialist, but

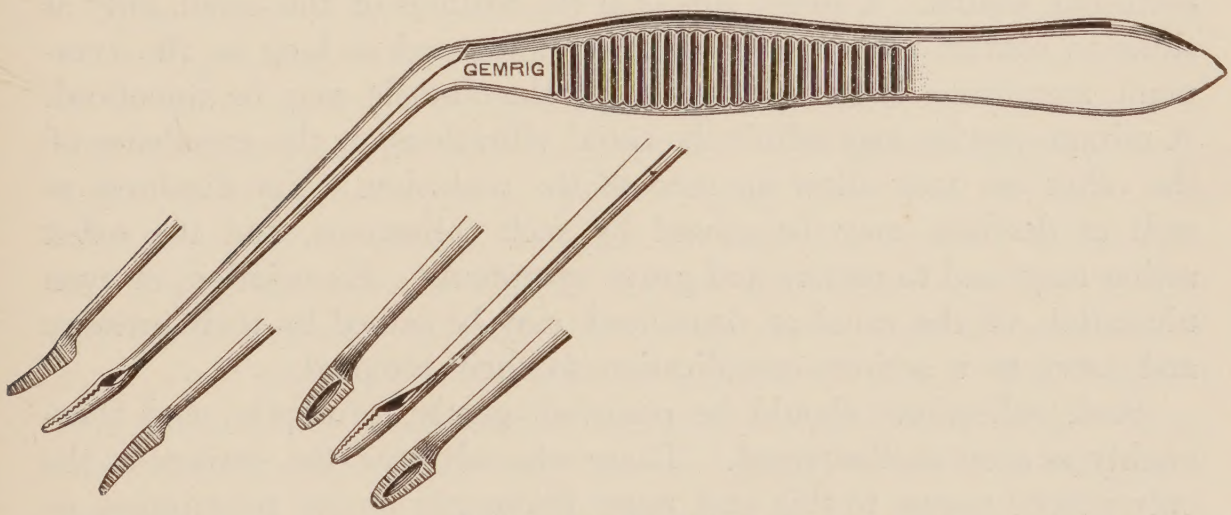
FIG. 157.



Harrison Allen's Cotton-carrier.

it is only the needless, unteachable blundering of many general practitioners which forces him to claim any exclusive right in the field. For this aurists are not blameless, since in their contracted field of operation perfection of apparatus is generally requisite; and yet the clumsy instruments often depicted would absolutely preclude delicacy of employment even in expert hands. True as it is that most aural cases arise from diseased conditions of the naso-pharynx, and are to receive their most important benefit from treatment of that region, there yet remains much to be skilfully done in the auditory canal by delicate hand, sharp eye, and judicious brain. Whoever undertakes to treat these cases can do them justice only by educating his faculties by practice in scrupulously careful manipulation.

FIG. 158.



Delicate Angular Forceps.

Within the auditory canal three conditions deserve special consideration as constituting the predominating affections: impacted cerumen, eczematous or diffuse and furuncular or circumscribed inflammation.

Impacted Cerumen.—As the cerumen is secreted by modified sweat-glands which are almost wholly absent along the inner third of the auditory canal, cerumen will rarely enter the deep portions of the meatus or come in contact with the drum-membrane except as the result of meddlesome manipulation. There is a remarkable activity

of growth of the epidermis at the centre of the drumhead, which generally tends to shift the entire lining of the external ear outward. A constant migrating tendency, therefore, moves the epidermal covering and all that clings to it far enough out into the cartilaginous canal to be within the influence of the movements of the jaw. Collections at this point are then generally moved outward, since the hairs serve to prevent their inward movement, and may even act as spring ejectors to throw cerumen pellets entirely out of the meatus. A healthy ear will therefore secrete considerable quantities of viscid yellowish wax, which dries and is extruded in unnoticed flakes as it approaches the exit.

Inflammatory lesions of the tympanum, as well as those of the meatus, usually decrease or suspend the secretion of wax, but so modify its character (perhaps as the direct result of increased temperature) as to cause it to collect in masses. The concurrent shedding of the hairs in the outer part of the canal adds another element to the collection, and the mass, acting as a foreign body, leads to increased epidermal exfoliation ; hence the formation of large, dense obstructing accumulations, consisting of dark wax, matted hairs, and shreds of epidermis. Unwise efforts to remove these or ultra-cleanly interference with the fairly normal secretion are apt to force the masses inward, until by their own accretion, or more often as the sudden result of swelling of the hygroscopic material on the penetration of water into the ear, total occlusion results. Usually this is at the isthmus of the canal, only at times in contact with the drum-membrane; and so long as the tympanic membrane is not pressed upon the obstacle may be unnoticed. A minute crevice may admit the aërial vibrations, or the excellence of the other ear may allow no note of the occlusion. Yet dizziness as well as deafness may be caused by such collections, and the reflex action may lead to remote and grave symptoms. Excoriation, or even ulceration, of the canal or drumhead may be caused by their pressure and serve as a serious complication to their removal.

Such collections should be removed gently, promptly, and thoroughly as soon as discovered. Those who advocate the syringe as the only proper means to this end must frequently ignore promptness as important. Instillations of oil, glycerin, or alkaline fluids for a day or two must at times precede the syringing, and very vigorous, prolonged, and repeated efforts may be then requisite before success is attained. Damage can be done by the stream of water, since this must be often very forcible, and the inflamed tissues may yield more readily than the adhesions to them of the ceruminous and epithelial mass. Yet it is a fact that in clumsy, unskilled hands (if they must needs exercise themselves in this field) there is less risk of injury from the syringe than from any other instrument. The assumption that anybody can prop-

erly syringe an ear is far from true: much care is requisite to do it rightly, so as to secure a safe and successful result. Any form of syringe may be employed unless it be too utterly puny to accomplish anything within a reasonable time. If a piston syringe, it should work smoothly and not by jerks, as it must be judiciously controlled. The fluid should be as hot as can be comfortably borne, and there is doubt that anything is superior to plain water. The injection should begin very gently, and be directed along the upper posterior wall as a rule, the canal being illuminated all the time and the force of the stream being gradually increased as tolerance permits. Dizziness and faintness frequently result, especially if the fluid is not warm enough or is used too violently; and the patient should in this, even more than in other aural manipulations, be forewarned and urged to announce the first feeling of the sort. If faintness be marked, the chair may be promptly tilted back, with the patient steadied in it, until the knees are higher than the head, which may rest upon the surgeon's knee—a position which can be easily maintained for any length of time, and yet be instantly changed to that previously held. This is usually much better than the more difficult and trying manœuvre of laying the patient flat, and is less likely to cut short the attempt to complete the syringing. Under proper precautions such an accident is not apt to recur, and if the patient has not been unduly alarmed the effort may soon be cautiously renewed and pushed to a successful issue.

The stream of fluid may accomplish its purpose in two ways: either by finding its way behind the mass and pressing it forward in its entirety, or by softening and disintegrating it layer by layer, until the last portion is washed out by the return stream. Either necessitates pressure upon the drumhead equal to the dislodging force, first or last. This may be greatly lessened if the mass be cautiously loosened by manipulation with the probe or curette, and accumulations may be promptly and gently washed out, which the syringe alone could have stirred, if at all, only after the use of pints or gallons of water. Yet it should be a fixed rule of aural practice that such a procedure is wholly unjustifiable unless the practitioner can see exactly what he is doing, and can trust both his own steadiness and that of his patient. With foreign bodies this rule is still more rigid, and only a considerable experience and skill, perfect quiet on the part of the patient (generally only under narcosis), and certainty that the syringe cannot succeed, will justify the attack which has too often been the *first* instead of the *last resort* of the unskilled physician. A delicate cotton-carrier, guarded by a pledget on its tip, may often disengage a hard mass or press aside pasty cerumen, so as to form a passage for the fluid along the upper back wall. The "ear-spoons" often seen are too large and clumsy: a delicate curette or sharp spoon, which can bite into the mass and

channel out its way, is better; and the very danger of its sharpness ought to put its user the more on his guard. It must touch the wax only, never the wall, unless very gently with its back.

Although not originally collected near the drum-membrane, the cerumen may have been forced down into contact with it, and furnish on removal an exact cast of the bottom of the canal. Such a cast is very difficult to remove by reason of its shape, and if of hard, unyielding form, like a metal cast, could not be withdrawn except by the grossest violence. Excoriated or even deeply-ulcerated surfaces may be found on the walls or membrane, making painful any movement of the obstruction, however gentle, and calling for treatment when all is clear. Syringing of the canal should always be followed by gentle drying with absorbent cotton, and impalpable boric powder lightly dusted on the abraded surfaces will generally secure prompt healing. As the cerumen tends to absorb water and swell, it is very important to remove all that is present at one sitting if possible, else the patient may feel distinctly worse for the interference and too ready to abandon the treatment.

As above noted, the inspissation of the wax marks in most cases a lessened and altered secretion, symptomatic of deeper trouble. Retraction, thickening, and dulness of the drum-membrane, as well as injection from the manipulation, may be found after its removal and call for attention to the nares, Eustachian tubes, and tympana. The other ear should always be examined, although claimed to be in perfect condition. Its appearance, if healthy, furnishes the best standard with which to compare the departures from normal on the affected side; while, as a fact, its condition is often found apparently worse than the affected ear, an invisible crevice allowing the waves of sound to reach the tympanum past a mass which seems totally obstructing. A distrustful patient may permit no manipulation of the "good ear," which gives him no trouble, but he would never cease to deride the attendant who failed to discover and advise him of the need of such treatment.

Diffuse Inflammation of the Canal.—Next in frequency and importance as affecting the auditory canal is the diffuse inflammation, which may generally be considered as eczematous. A slight degree of this affection is very common, giving rise to some itching and scaliness of the outlet of the canal, which attracts the patient's attention, and too often his interfering efforts to the ear. It has given the name "l'auriculaire" to the little finger of the Frenchman; but this natural (?) instrument is too commonly replaced by the woman's pin or hair-pin or the man's tooth-pick, with resulting traumatisms, including lacerations and punctures of the drum-membrane. A low grade of eczema is rarely absent in the gouty, and gives rise to occasional fissures below the lobe and in the helix, as well as to the lesions within the canal. In

strumous children—using that term to cover the numerous forms of malnutrition, whether due to inherited taint or mere faulty assimilation —there is much tendency to eczematous inflammation from small lesions, and any discharge from the tympanum is apt to excite so much reaction in the external ear as to mask more or less completely the deeper lesion. The sulcus back of the ear is almost always especially affected in such cases, and deep, readily bleeding fissures are common.

To term these lesions eczematous at once indicates the varied forms of discrete and confluent, moist and dry, trivial and obstinately intractable inflammation which may be thus met, and the wide range of medicinal measures for which they may call. Every grade of severity may present itself, even in the same case, from a desquamation that is hardly abnormal to a phlegmonous inflammation so erysipelatous in type as to leave the differential diagnosis wholly in doubt, and call for most active constitutional treatment. A point of some diagnostic importance in the mild cases is the stiffness and lessened mobility of the ear, due to the induration of the subcutaneous tissues, which will generally remain long after the superficial evidences of the disease have disappeared or lapsed into abeyance. In the severe cases the moderate hyperpyrexia, the limited swelling, and especially the surface lesions, will generally distinguish it from erysipelas.

As to treatment, the multitude of the recommended measures too plainly tells of the limited value of any one; and that which was at first most valuable may often be advantageously replaced a little later by one usually inferior. Having early imbibed a prejudice against watery applications in the treatment of eczema, I have habitually avoided them, cleansing generally with fluid cosmoline and using a similar excipient for medicinal applications. Animal and vegetable oils are inferior from their liability to become rancid within the canal, and may make matters worse. No one rule will serve for all cases, and excellent results are certainly obtained by those who douche the more acute forms with tepid water and strenuously abjure all oily applications. Silver nitrate is often of great value in the moist acute form, its application being best made with the pledget of cotton after careful cleansing. The impression should be a strong one, giving a thick protecting film over the surface by persistent use of a 2 per cent. solution or the more careful painting with a stronger one. The reaction may be severely painful; so it is better to treat thoroughly only a limited area until the degree of tolerance is learned. For the milder types the careful inunction of calomel has generally proved so efficacious in my hands as to leave no great room for experiment with other candidates for favor. Ichthyol in 5 to 10 per cent. vaseline ointment has undoubted value for the reduction of the deeper infiltra-

tion, and certainly often equals the older favorities. Internal treatment must aid the local means, full doses of tincture of chloride of iron being probably best in the erysipelatous type, arsenic in the more dry and chronic forms, and iodine, best as syrup of hydriodic acid perhaps, in the gouty cases.

Furuncle of the Canal.—Out of an almost unnoticed diffuse inflammation there may arise the circumscribed or furuncular form, which is a frequent and rather severely painful disease. Questioning will so often reveal that an itching ear has been scratched and the furuncle arisen at an abraded point that this may be taken as the usual origin of the lesion. The advanced pathologists tell us that micro-organisms are responsible for all cases of circumscribed and diffuse otitis externa, furnishing a ready explanation of this phenomenon, as well as why these furuncles by auto-inoculation are so apt to occur in series. Some, indeed, contend that they are contagious. In any event, a depressed condition of the general system is an almost invariable substratum of great importance, and much of the promptness and completeness of recovery will depend upon the general tonic measures employed. Typical antiseptic measures have been long the most used, such as very hot syringing or fomentation, the inunction of the yellow oxide of mercury, or painting with pure carbolic acid. The pain may be extreme, and the deafness from the closure of the canal by swelling or secretion such as to raise the question of tympanic involvement. Leeching in the earliest stage may serve to abort the attack as well as relieve the pain, and in later stages it may soothe without causing so much relaxation as to retard resolution. Incision is indicated as soon as pointing is visible, and when judiciously combined with vigorous cleansing and stimulation may greatly abbreviate the attack. The deeper portions of the canal are not likely to become involved, since they lack the glands which are invaded; so the prognosis as to hearing is favorable; but the recurring furuncles may seriously exhaust the patient by pain and loss of sleep, and the affection cannot be regarded lightly. Local anæsthetic measures, except heat and bloodletting, are of little avail. Morphine by the mouth or hypodermically is far more reliable. Poulticing is to be condemned as inferior to hot fomentations, which must be changed often enough to be decidedly stimulating: moist warmth may feel grateful by causing relaxation of the tense tissues, but it will generally delay resolution, and may encourage exuberant polypoid granulation from open furuncles. As soon as it can be borne pressure by conical cotton pledgets covered with an ointment of yellow oxide of mercury will materially lessen the induration, all pus having been first evacuated and the cleansing of the whole canal completed by hot water, peroxide of hydrogen, and mopping. There is undoubted possibility of transfer of infecting material to

other parts of the patient or to other persons, whether the microbic theories be correct or not; so care and cleanliness are very important. The other ear of the patient will often show a slight desquamative and itching condition, which throws light on the furuncular affection and calls for prophylactic treatment.

Fungous Aural Disease.—The typical fungous disease of the ear is caused in most cases by one of the forms of aspergillus, but is rare enough to be only occasionally observed by the specialist, although an additional group of suspicious cases should perhaps be counted with them. Its true character may be readily overlooked if cerumen impaction is present, the inflammatory condition of the walls being ascribed to the irritation of the wax-mass or the efforts for its removal. Pain is probably the most important diagnostic sign, since cerumen impaction rarely gives pain, and sudden periodic recurrence is also rather characteristic. The walls of the canal may be so swollen as to afford a very unsatisfactory view of the fundus, which is generally filled with a moist solid material, resembling in the most typical cases wet newspaper with its mingled white and black. Generally, however, the material consists of epidermal flakes upon which no mould can be recognized, or of cerumen with such flakes covering its deeper portion. It is well in all suspicious cases to place some of the flakes on removal in a small bottle with a little damp cotton in its mouth, and preserve it for a few days in a warm place, such simple means serving beautifully to give a luxuriant culture of any mould present, and clearing the doubtful diagnosis. Copious syringing is regarded as the best means of cleansing by many authorities, but I have generally found mopping with the cotton-carrier necessary as an aid. Of the numerous germicidal solutions recommended, such as fresh hypochlorite of lime (2 grains to the ounce) or alcohol, none probably excel the peroxide of hydrogen, which rarely causes any discomfort if mopped over the surface in full strength, while materially aiding the detachment of the collected material. Dusting the dried surfaces with impalpable boric-acid powder, to which Burnett adds chinoline (1 : 16), rarely fails to give prompt relief from the irritation and does much to arrest the growth. Such cases should be watched, however, as the mycelial filaments may have invaded the tissues or in rare cases have found their way within the tympanic cavity; so total eradication may not be at once possible. Recurrence may occur also through renewal of the conditions, not easily determinable or avoidable, which gave rise to the first attack. Some five forms of Aspergillus and a number of allied fungi have been found in such cases, the *A. nigricans* being the most common; but the clinical picture is independent of the precise form of the parasite, and the treatment the same for all. The use of oil in the ears, which is so common in domestic practice, is charged with the

causation of a number of these cases, its rancidity soon giving rise to the inflammatory condition which furnishes the favorable soil for such growth. Moisture is doubtless essential; so the drying effect of the boric-acid powder is an important matter, and after its habitual use recurrence has been so rare in my experience that the tendency might be doubted except for the general testimony regarding it.

Caries of the Bony Canal.—As the result, perhaps, of the furuncular form of otitis externa we may have a more severe and deeper affection, laying bare the bony wall and giving rise to caries and loss of substance. Such cases are relatively uncommon; but their increased importance and the great difficulty of differentiating them from those in which mastoid suppuration opens into the auditory canal claim for them careful consideration. They are apt to exhibit polypoid granulations arising from some part of the canal wall, and the sinus which is invariably present can generally be found and entered by a fine probe, which will then pass down to bare, rough, and generally carious bone. Such polyps of the canal, unless clearly due to poulticing of a furuncle, may be accepted as indicating involvement of the bone. Injection of the tympanic membrane will rarely be lacking, and pain, tenderness, and swelling may further suggest a mastoid lesion; but the hearing will usually be fair when the meatus is free, the sinus cannot be followed to any depth in the bone, and the course of the case, though slow and tedious, will be more favorable than when the real focus of inflammation is deeper and less accessible. The condition is a localized periostitis of the canal-wall, and is essentially the same as the periostitis externa of the mastoid, to which it may readily extend. It should always be suspected of being due to penetration of pus through the bone from the antrum or mastoid cells, which lie close beneath the affected point, or to subperiosteal burrowing from the tympanic attic. Evacuation of retained pus, thorough cleansing of the suppurating track by syringing and mopping, clearing of the sinus-mouth by snipping off the granulations as they protrude, and cauterizing cautiously with chromic acid, stimulation of the sinus (and perhaps decalcification of any dead bone) by dilute mineral acid in 2 to 4 per cent. solution of iodine, and at need curetting the unhealthy tissues, will generally give a safe and fairly prompt healing with retraction.

Hyperostosis of the Canal.—Akin to the carious lesion of the bony wall is the hypertrophic inflammation which gives rise to bony atresia of the canal or the formation of exostosis. A pedunculated form at times affords clear evidence that a polyp has undergone ossification; but usually the broad sessile growth of ivory hardness speaks for a hyperostosis of the tympanic bone, most marked, as a rule, at one or more points. Suppuration has almost always preceded such formations, and appears to have been the exciting cause, perhaps by the

deeper extension of the irritating effect of the discharge which so commonly excoriates the surface. Clinically, we find a rounded yellowish mass protruding from one or more points into the lumen of the canal, sometimes almost totally occluding it. Such growths are often multiple, and may increase until flattened by mutual pressure and practically close the canal. A chink will generally remain between them, however, and they are rather self-limited in their growth; so surgical intervention for their removal should be reserved for those cases in which great reduction of hearing or threatened retention of pus demands decided measures of relief. Iodine and pressure may act sufficiently upon the soft tissues covering the nodules to maintain an adequate opening, and careful syringing and probing will bring away the collections of epidermis which form dangerously beyond them. Pedunculated masses may be readily removed, but those with broad bases offer serious obstacles to the surgeon's success, and their removal is attended with no small danger to life. The burr and dental engine have done good service, as have cutting forceps, files, and saws; but the chisel directed to the cancellated bone from which the eburnated mass arises is the surest means of removal. The ivory tissue itself may break every tool that is employed upon it. When useful hearing has been previously destroyed or when there is suspicion of antrum-caries or cholesteatoma as the source of suppuration, the more radical trephining of the mastoid may be the safer and better operation, combined, if desirable, with the removal of the posterior wall.

Laminated Epidermis.—An important condition is quite commonly met in which the external canal is occupied by a more or less cerumen-like plug, which proves on removal to consist of laminated epidermis. Desquamative inflammation, as this condition is commonly called, is almost invariably a secondary affection, the seat of the epidermal exfoliation being cicatricial tissue covering the ravages of a previous destructive inflammation and clothed by cells of peculiarly rapid proliferating power, probably derived from the tympanic membrane. The canal-walls and the remains of the drum-membrane may be involved in the process, but its most frequent and important seat is in the tympanum, especially its upper and posterior portions—the attic and antrum. How often there is a true primary cholesteatoma-formation here (the margaritoma of Virchow) does not concern us in this section, but it is essential that we recognize that any involvement of the external ear by this process, and the formation of the "sebaceous tumors of the canal" (Toynbee) are secondary to serious and intractable middle-ear disease. Removal is difficult, but should be pressed to completion by gentle, persistent use of syringe, probe, curette, and forceps; and the clearing of the external ear will form the beginning in most cases of the more difficult task of freeing the tympanum and its adnexa.

The exact source of the growth is to be sedulously sought by displacing every flake not organically fast to the living tissues, and the back wall especially scrutinized in search of any hidden opening into the mastoid, where huge masses of the pearly growth may be hollowing out the bone by their pressure or even invading the cranial cavity.

Foreign Bodies.—The subject of foreign bodies has been already touched upon. The essential point to be remembered as to them is that their presence rarely does harm: it is almost always the unwise effort at removal which converts an unimportant into a serious condition. It is a most false and pernicious pride which impels the practitioner to whom such a case comes to persist in his damaging efforts, rather than withdraw empty-handed and confess failure. Unless he or some one else has done damage the body may remain for years harmless, as countless records prove. The panic of the friends or patient should be quieted first, and the gravity of injury explained to be greater than that of failure to remove the object: such an explanation made after failure may fall on incredulous ears. Inspection should first be made to find if a foreign body be actually present; and here, as generally, the other ear may wisely be examined for one which has been forgotten: it can at least give an indication of the size and configuration of the canal in which we have to work. In children (who constitute the majority of the sufferers) the auditory canal is to a greater extent cartilaginous than in the fully-developed adult condition, and this movable portion of the canal is so mobile that rotary rubbing in front of the ear, especially if aided by gravity, will often work a smooth and slightly impacted body promptly to the exit—a manœuvre worth trying even if the syringe and other instruments are at hand. The syringe is far the best instrument even in experienced and skilful hands. Besides the inspection, very gentle probing under full illumination to determine the form, size, and mobility of the foreign body, and perhaps to begin its dislodgment, is the first step to a proper diagnosis; then careful, persistent hot syringing is the treatment. It should need no urging that pebbles and such bodies will not float, and that gravity is better as a helper than as an opponent; yet it is very rare to see the syringing done with the ear directed downward. The illumination should generally be maintained, both as making the syringing more intelligent and as compelling the straightening of the ear by traction in the direction best adapted to give the water freest entrance and the body readiest exit. Undue caution is sometimes urged as to syringing with water to remove seeds and such bodies as can swell by absorbing it. Not enough should be absorbed by an hour of vigorous douching as to effect such a result, and the dehydrating use of alcohol, etc. may follow at once upon the failure of the water to remove the intruder. Where living insects, as maggots or beetles, are present, oil may be wisely substituted if at

hand, since it kills many which seem only stimulated to more painful movements by water. A little chloroform vapor or a drop or two of the fluid will kill the most resistent.

An impacted foreign body is often retained immovable because its largest diameter no longer corresponds to that of the canal, and gentle rotation by a probe or curette may at once dislodge an obstacle which direct traction or the gentle posterior pressure of syringing would only more firmly fix. Delicate, intelligent manipulation under good illumination is more conservative and rational than the use of a syringe with force enough to rupture or otherwise injure the drum-membrane; and traction instruments—the wire loop, curette, blunt hook, and forceps—have their place in the hands of competent men. But a thorough appreciation of the anatomy of the field and skill in such manipulations are requisite: such are rarely possessed except by the experienced specialist, who meets five or ten of these cases in a thousand. No damage to the tissues must be done by these efforts, and their employment is to be discontinued after a few unsuccessful attempts. The ear should be gently dried by absorbent cotton, dusted lightly perhaps with boric-acid powder, and the removal deferred; or the agglutination method may be tried by carrying a brush charged with stiff glue into contact with the body, and, after it has dried and become firmly attached, drawing or coaxing the intruder out by its hold upon it. Forceps, except those specially designed for the purpose, are generally very dangerous means to employ: they rarely permit a good view of the body as the effort is made to grasp it, are generally too clumsy to pass between it and the walls, and in slipping are very likely to force the body deeper, perhaps through the drumhead into the tympanum.

In cases of serious impaction, where dangerous and urgent symptoms have already appeared (rarely if ever except as the result of extraction efforts), the auricle should be turned forward by an incision close behind it, the cartilaginous canal dissected away from its attachments, and the extraction then done in the short bony canal thus laid open to easy access. The chisel may be needed to secure room above or behind the foreign body, and leverage or strong traction then employed. When the body has been pushed through into the tympanum, serious traumatism has generally been already done, and a considerable series of fatal cases due to this cause are on record. This should be clear to those concerned before any operative intervention is begun. The patient is to be kept in bed, and general antiphlogistic treatment employed, such as freeing the bowels and securing a mild mercurial impression. Leeching, cupping, and blistering the nape of the neck, the ice-bag to the head, and such measures should promptly follow the appearance of serious constitutional symptoms.

DISEASES OF THE TYMPANIC MEMBRANE.

THE drum-membrane is rarely the seat of primary or strictly limited disease, but shares in almost all of the inflammatory affections of the external and middle ear, of which its outer and inner surfaces, respectively, are parts. Traumatic lesions, such as rupture or puncture, may be limited to it, and certain inflammations so focus their intensity upon it that we may make the diagnosis *a fortiori*—myringitis. Many forms of interesting lesion may be seen upon or through its surface, and hundreds of pictures would be requisite adequately to portray its alterations; but from a therapeutic standpoint these deserve little more than passing notice as indications of wider trouble, calling for other than local treatment.

The perfection of the smooth, healthy epidermis of the drumhead is shown by the brilliancy, and that of its position by the form, of the light spot, which should appear under good illumination as a silvery triangular reflection upon the lower anterior portion, with its apex at the centre of the membrane and its base fading at the margin. Any departure from the normal shallow funnel-shape will be revealed by shortening, narrowing, or other change in this triangle or "cone (?) of light," and a reflection from any other part of the drumhead is wholly abnormal and noteworthy. The malleus handle should be clearly visible, extending from the centre up and forward to the margin of the membrane, where a pearly prominence marks the position of its short process—a most important landmark in all these studies. The color of the drum-membrane is a peculiar pearly gray, its exact tint depending upon the transparency of the tissue and the color and proximity of the inner tympanic wall beyond: it is therefore darker over the niche of the round window and over the opening of the Eustachian tube, yellower behind the hammer-tip, where the promontory shines through, and whiter peripherally where the lower four-fifths of its margin is thickened by the fibrous tissue of the annulus tendinosus. No blood-vessels are visible to the unaided eye in the normal membrane, but a slight irritation will distend the plexus behind the malleus handle, and any degree of vascularity up to vivid congestion may be seen. The introduction of a speculum, unless extremely gentle, may cause such injection by its pressure upon the efferent vessels which pass out along the anterior wall of the canal; so it is desirable to take note as to this before using a speculum. Backward from the short process runs a ridge, the posterior fold, which is usually inconspicuous in the normal state, but becomes pronounced and prominent in most cases of depression of the drumhead, when the other folds in this region may also become unduly distinct. The malleus handle generally seems to reach a little below the centre of the membrane, and to

stand out but little above its surface: it may, however, be much foreshortened by retraction, and drawn forward or back of its normal line, while at times the depression of the membrane around it may make it stand out almost as if it were naked and separate from the drumhead. These depressed conditions are generally due to pressure of the external atmosphere upon a membrane unsupported from within, occlusion of the Eustachian tube preventing the renewal of the tympanic air, which is gradually absorbed by the walls of the cavity. With many other alterations they will receive attention in the sections on middle-ear disease.

Diseases of the Drumhead.

The strictly localized affections of the drumhead are almost invariably traumatic, such as rupture, puncture, extravasation, and ulceration. Rupture is not uncommon in the case of severe head-injuries, when bleeding and perhaps copious serous discharge may suggest fracture of the base of the skull extending into the tympanum or canal. It is entirely possible, however, that such symptoms may be due to the local lesion, for numerous cases recover with no other evidence of the graver injury; and the vessels of the drum-membrane may bleed very freely, and the tympanum is capable of secreting pints of fluid resembling the cerebro-spinal. The external canal also may be involved in such a fracture, especially if violence has been transmitted through the condyle of the lower jaw. Pneumatic pressure is also responsible for many ruptures, especially in the form of explosions or of a blow upon the ear, as in boxing the ears. Toynbee laid stress upon the importance of unexpectedness in such cases, and was skeptical as to the yielding of a normal membrane except to extreme violence. The tear in the membrane is generally linear, oftenest midway between the malleus and the back margin but may be located in any portion, and have an oval, quadrate, or other shape. Healing is the usual result if meddlesome treatment is avoided, and, unless coincident concussion of the labyrinth has occurred, hearing may be perfectly restored. The punctures generally result from the introduction of pins, etc. to scratch the ear, though occasionally from the accidental penetration of a twig, their form and character depending upon the vulnerating body. Ulceration may take place after pressure of a foreign body or cerumen-plug forced down into contact. Extravasations may occur from violent strains, as in a paroxysm of whooping cough, or from direct injury. Expectancy is advisable in the treatment of all: protection by a pledget in the exit of the canal, antiseptic if so desired, will generally suffice, with avoidance of violent blowing of the nose, etc. Syringing, mopping, or other interference should be reserved until suppuration or severe pain, unrelieved by dry heat, calls for intervention. Inspection is of course desir-

able, and to this end blood-clots may be lifted from the canal in the search for any foreign material remaining behind; but even this had better be omitted unless there is reason to suspect such a complication. If suppuration supervene, it is to be treated as an acute otitis media.

Cold, whether from air or water of low temperature entering the auditory canal or from less direct impression, may give rise to a middle-ear inflammation of which the brunt falls upon the membrane; and in the absence of much dulness of hearing or other signs of general tympanic involvement we may term the condition myringitis. The acute form is marked by injection of the membrane, which may bring out clearly the radiate plexus of vessels covering its intermediary portion or blend into a partial or general area of redness; by epidermal haze, thickening, maceration, or exfoliation, perhaps with formation of blisters of limpid or bloodstained contents; and, subjectively, by stabbing or throbbing pain with little fulness, deafness, or re-echoing of the voice through the head. The nares, pharynx, and Eustachian tubes may be normal, and the affection may be strictly one-sided, as is less often the case with acute otitis media. The separation of the cuticle at times leaves the drumhead denuded, granular, and bathed with discharge, which may become purulent or pseudo-membranous: villous or polypoid outgrowths may form and the condition tend to become chronic.

The treatment should at first be rather expectant, with dry heat, leeching, and gentle hot douching to control the pain. Inflation of the tympanum is only called for by the onset of decided deafness. Instillations of any sort may do more harm than good, and only very light dusting of the surface with boric-acid or other powder is at all in place. The drumhead undergoes prompt spontaneous healing in most cases if well protected; but when moist, denuded, and perhaps granular, as a more chronic condition, it may call for vigorous dusting with boric or alum powder, painting with nitrate of silver or tincture of chloride of iron, and the internal use of tonics and alteratives.

The formation of abscesses and pearly or warty growths need hardly be referred to, because of their rarity; but tubercles may occasionally be recognized in the drum-membrane, and be of diagnostic importance as well as of most unfavorable prognosis. The yellowish punctate prominences soon tend to break down and form perforations, which only by their multiplicity indicate their specific character. The presence of more than two coincident perforations should arouse a suspicion of tuberculosis.

ACUTE DISEASES OF THE MIDDLE EAR.

By ROBERT BARCLAY, A. M., M. D.

Disease of the middle ear may occur under one of two conditions—either alone, as simple local inflammation, or as an intercurrent inflammatory feature of general diseases. For instance, acute purulent otitis media may occur alone, when we find local and, usually, general symptoms, the latter dependent upon the character and intensity of the local inflammation; or, on the other hand, the same lesion may occur as a feature of one of the exanthemata, such as scarlatina, the local inflammation being due to the influence of the poison of the general disease. Moreover, the local organ and the general system may be mutually retroactive, thus producing or aggravating both local and general symptoms of the morbid condition. In either case, therefore, we have at least two distinct sets of symptoms, but of different nature and development and of unequal intensity; and it is important, especially in morbid conditions endangering the life of the patient, to bear this distinction in mind and to differentiate symptoms accordingly.

It has been well said by J. Orne Green:[1] "Symptoms, however slight, should not be neglected; the natural course of the disease, whatever its variety, should be understood and its course watched; if necessary, local or general treatment should be used to assist nature; and, finally, the case should remain under observation till recovery is perfect or as nearly so as the particular disease will admit. This latter point, the insurance of perfect recovery, is all-important, for a little remaining disease may be sufficient to produce hypertrophy of the mucous membrane, which will go on insidiously for a long time before it is noticed by the patient."

From the fact that the actual existence or non-existence of aural disease cannot be determined without physical and otacoustical examination, and from the fact that the transformation of a comparatively harmless into an extremely dangerous condition of aural disease may occur suddenly, we should at frequent intervals note the character and progress of the disease by inspection, auscultation, and otacoustic examination of the middle ear and Eustachian tube.

[1] "The Importance of Early Recognition of Ear Disease," *Report of Annual Meeting of the Mass. Med. Soc.*, June 9, 1880.

Concerning one visible portion of the middle-ear tract, the membrana tympani, it may be said that it is the translucent window of the middle ear, the frame on which are hung the therapeutic signs of otitis media, the screen upon which are projected the dissolving-views of middle-ear disease. Upon this membrane the careful practitioner constantly keeps a watchful eye, as there he can ascertain the needs of his patient.

It must be remembered that the ear, although an organ of special sense, is neither separate from nor independent of the organism at large. It is constructed of and contiguous to bone, cartilage, muscle, skin, nerve, serous and mucous membrane, blood-vessels, and lymphatics, which are liable to the same diseases, subject to the same vital laws, as corresponding tissues elsewhere. Hence it is that the treatment of diseases of the ear, more especially of those of the middle ear, depends, as a rule, upon the existence and character of extra-aural or constitutional factors rather than upon local aural conditions alone. Mr. Erichsen has said: "In undertaking the curative treatment of inflammation the surgeon must not allow himself to be led away by the name of the affection with which he has to do, but he must be influenced in the means that he adopts by the constitutional condition of the patient, by the type of the inflammatory fever, and by the state of the diseased part; for nothing presents greater variety than the management of the inflammatory process in different conditions of the patient and in the different phases of the disease." [1]

This brings us, practically, to a consideration of certain radical principles which apply to the management of cases of middle-ear disease in general; and there are certain precautions to be taken, certain circumstances and conditions to be carefully investigated, and if abnormal rectified, in every case of middle-ear disease if the practitioner intends to proceed upon the cardinal principle of rational therapeutics.

The *age* of the patient should be ascertained and considered: first, because the peculiarities of structure of the ear at different stages of development after birth may modify the course of the disease; and, secondly, because a knowledge of the age will assist us in estimating the degree of influence exercised upon the ear by changes taking place elsewhere in the body. For instance, from about the seventh or tenth month of age until the second year, as a rule, teeth are cut. The development, crowding, and decay of these exert by reflex irritation a marked influence on the predisposition to and production of aural disease, and should therefore be carefully noted and attended to remedially. At the age of three, six, and twelve years, approximately, the eruption of the so-called three-, six-, and twelve-year molar teeth occurs, and between the above ages the intermediate dentition or dental disease, if any, may

[1] Erichsen, *The Science and Art of Surgery*, Lea Bros. & Co., 1881, p. 147.

so strongly impress the ear that this factor should not be overlooked. Should such irritation be present, in addition to local treatment directed against the dental and aural local condition remedies which tend to restore vaso-motor tone and renew activity—such, for example, as hydrobromic acid and strychnine—are indicated. In young children the writer has found chamomile of great service in aural troubles associated with dental or gingival irritation, especially that attending the eruption of the deciduous teeth. We may use chamomile as advised by Ringer,[1] "by steeping four to six heads of chamomile-flowers in a tea-cupful of boiling water for an hour, and then giving a tea-spoonful every hour."[2]

On the approach of puberty we may look for aural trouble due to the tonsillar enlargement often occurring at this period. The enlarged tonsils after this sexual crisis has passed return, as a rule, to a normal condition.

In females, especially at this period, the nervous system is in such a hyperæsthetic condition that its influence is often manifested on aural disease.

The indication is for remedies checking glandular enlargement, hypertrophy, and hyperplasia, and those promoting reabsorption of plastic exudates, yet they must not be pushed so as to disturb general growth or the integrity of healthy tissue. For example, the internal administration, after meals, of the syrup of the iodide of iron, well diluted with water, with local application of astringent solutions—notably those of the ferric salts—is useful. At the age of puberty the patient should be removed from circumstances and associations tending to nervous excitement, while auxiliary remedies to soothe nervousness should be employed judiciously and as sparingly as possible.

At about the sixteenth or nineteenth year of age, or perhaps somewhat later, the eruption of the third molar or "wisdom" teeth may be expected. Rarely these teeth do not appear until late in life. In many cases, however, for years after the teeth are full grown they are partially overlapped from behind by a finger-like extension of the gum, which, although seemingly a trifling abnormality, nevertheless aggravates aural disease in many cases.

In middle age we look for all those troubles due to exposure, hurry, the over-work and worry of commercial competition, or the pinch of necessity in the struggle for existence—catarrhal inflammation, neglected personal hygiene, uncleanly or diseased teeth, inactive skin, irregular diet, and insomnia, each of which may be a causative factor in aural

[1] *Handbook of Therapeutics*, 1875, p. 571.

[2] See also Sexton, "On the Affections of the Ear arising from Diseases of the Teeth," Prize Essay, *Amer. Journ. Med. Sciences*, Jan., 1880, abstract *Dental Cosmos*, Feb., 1880, p. 92; *ibid.*, "The Care of the Teeth from a Medical Practitioner's Standpoint," *Med. Record*, 1889, No. 35; Barclay, "On the Relation between Diseases of the Teeth and Ears," *Med. Record*, Aug. 3, 1889, p. 119.

disease, and as such merits due regard and appropriate treatment, as recommended elsewhere.[1]

Later in life we find, as factors in perpetuation of middle-ear disease, oral irritation from the artificial dentures worn after the teeth are gone, particularly if they are made of unsuitable material, notably vulcanized red rubber; shells of the crowns or remnants of the roots of teeth; gingivitis; hyperostosis dentium; pyorrhœa alveolaris; periostitis; pericementitis; tartar; hypertrophy of the gums; catarrhal inflammation of the buccal mucous membrane; numerous amalgam or imperfect fillings; and other oral sources of reflex aural irritation, too numerous to mention, should be looked for and receive attention. If our acquaintance with oral pathology be so limited as to leave reasonable doubt as to the existence of oral irritation or disease, we should seek counsel in diagnosis from a skilful dental surgeon; for if such oral irritant be overlooked success in treatment is delayed and often impossible.

In females between the ages of forty-two and forty-eight years, approximately, we may find aural disease arising from or aggravated by the menopause.

It should be stated also that *venereal excess or abuse*, masturbation, onanism, unnatural or over-frequent sexual indulgence, may so strongly impress the system as markedly to affect the ear and the course of otitis media.

The possibility of *idiosyncrasy* on the part of the patient to drugs and other remedial measures should be remembered.

Occupation and *environment* are important factors in predisposition, production, and persistence of ear disease.[2]

If he may do so, a patient suffering with otitis media should seek other occupation or environment if at the time engaged in that which is noisy, dusty, ill-ventilated, overheated, damp or moist, requiring night service or contact, direct or indirect, with noxious substances, in a draught of air, in condensed atmosphere, or with out-door exposure in inclement weather.

Habit and *hygiene* are potent factors in assisting or retarding recovery from ear disease. The use of alcoholic liquors, tobacco; the excessive chewing of gum; Turkish baths (except in the gouty or rheumatic diathesis); picking the ears; warm bathing; sea-bathing,[3]

[1] Sexton, "Catarrhal Inflammation of the Upper Air-Tract," *Med. Record*, Jan. 30, 1886; Burnett, "Reflex Aural Phenomena from Naso-pharyngeal Catarrh," *Trans. Amer. Otol. Soc.*, 1884, p. 273.

[2] Sexton, "Causes of Deafness among School-children," No. 5, 1881, *Circ. Bureau Educat.*, Washington, D. C.; Barclay, "The Whistle Signal: A Plea for the More Safe Management of Railroads," *Journ. of Nat. Assoc. of Rwy. Surg.*, Fort Wayne, Ind., July, 1889.

[3] Bacon, "Sea-Bathing as a Cause of Ear Disease," *Med. News*, Jan. 29, 1887; Sexton, "Diseases of the Ear from Bathing," *Medical Record*, May, 4, 1878.

wearing the hair too short or wetting it when brushing; wearing mufflers, boas, comforters, or other neckgear; wearing mackintoshes, furs, or other similar clothing for warmth; excessive or insufficient exercise; overfeeding, eating highly-seasoned food; tight lacing; the abuse of tea, coffee, chocolate, cocoa; want of the necessaries of life,—these aggravate and prolong aural disease, and should be discountenanced, and, if possible, discarded.

A *congenital taint* of such diseases as cancer, phthisis, syphilis, gout, scrofula, struma, and tuberculosis modifies the vitality, resisting power, and energy of certain tissues in the ear, as well as throughout the entire organism, which is manifested, for instance, as in rheumatism or in syphilis of the ear, and more or less modifies the choice of direct and indirect remedies.

Since *maltreatment* will modify the course of aural disease, it is well to ascertain what procedures have been employed by others at or before the time when the case is first seen by us, and we must estimate their influence in determining the character and extent of the underlying morbid process. Every procedure not directly beneficial should be discontinued at once. Especially harmful during acute otitis media are the use of the nasal douche, the sniffing up into the nose of water or other liquids, nasal syringing, nasal cautery, or surgical operations, since aggravation of aural trouble may result from nasal irritation, and since fluids used by such means are very apt to gain entrance to the middle ear through the Eustachian tube, notwithstanding the greatest possible care in their employment. This is a particularly dangerous accident, inasmuch as fluids thus projected into the middle ear are apt to pass over to the outer side of the malleo-incudal body in the tympanic attic, and there lodge in its outer compartment—the malleo-incudal niche or nook—where they often induce the most painful, incurable, and destructive inflammation.[1]

Inquiry should be made as to the *habitual use of narcotics;* the *abuse of systemic remedies*, such as quinine, for example; the frequent or prolonged *syringing of the ear*, so apt to cause maceration and to favor the growth of polyps. If any of these be found they should be at once prohibited.

Since in otitis media, characterized by a condition of vaso-motor paresis, the disease may persist, reflexly from structural lesions elsewhere, a general physical examination should be made with a view to discovering and removing, if found, any such existing cause of vaso-motor relaxation.[2]

[1] Buck, "On the Renewed Employment of the Nasal Douche and Kindred Procedures," *Trans. Amer. Otol. Soc.*, 1890, p. 547.

[2] Woakes, *Deafness, Giddiness, and Noises in the Head*, 1880, pp. 7, 128, 200, *et seq.;* Burnett, "Reflex Aural Phenomena from Naso-pharyngeal Catarrh," *Trans. Amer. Otol. Soc.*, 1884, p. 273.

The gravity of complicated cases of otitis media is such that special consideration seems due them. Dangerous complications are more apt to occur during the chronic than the acute stage (see Chronic Purulent Otitis Media), and as a rule arise from one of the following causes: deformity or imperfect development of the parts; a debilitated or deteriorated condition of the general system; very pronounced reflex aural irritation; improper therapeutic procedures which contribute new sustaining factors or intensify old ones; and neglect to meet the indications of the particular case, especially those calling for the re-establishment of vaso-motor tonicity and for the removal of secretions and diseased tissue.

Inasmuch as the indications for treatment of complicated otitis media vary indefinitely in the different cases, the treatment in general must be that based upon established therapeutic principles, modified by or conjoined with that based upon special ones, elsewhere discussed, for each particular variety of otitis media with which complications may occur. As a rule, however, if the treatment elsewhere recommended for otitis media prove insufficient to quiet the trouble, complications which arise will be amenable to aural surgical procedures only, for the full discussion of which the reader must be referred to works on aural surgery. In these cases especially the practitioner should not be content to temporize with further medicinal treatment exclusively, but proceed at once, in the manner recommended by the best authorities on aural surgery, to invade the stronghold of the disease and remove therefrom or counteract whatever may retard recovery. "The object of every operation is the removal of some condition that either threatens life or interferes with the comfort and utility of existence; and the more safely as well as certainly a surgeon can accomplish this object the better will he do his duty to his patients and the more successful will he be in his practice."[1]

[1] Erichsen, *op. cit.*, p. 72.

See the article on Chronic Middle-Ear Disease in this volume.

For a complete study of these questions the reader is referred to the following authors: Bacon, "Diseases of the Mastoid Process, with a Report of Cases," *Archiv. Otol.*, vol. viii. Nos. 3 and 4, 1889; Buck, "Diseases of the Mastoid Process, etc.," *Archiv. Ophthalm. and Otology*, 1873, iii.; *ibid.*, "On Certain Technical Details relating to Perforation of the Mastoid Process, and the After-treatment," *Trans. Amer. Otol. Soc.*, 1886, 623; Green, J. O., "The Treatment of Inflammations of the Mastoid, with an Analysis of Eighty Operations," *Amer. Journ. Med. Sciences*, Dec., 1890; Sexton, "The Question of Trephining the Mastoid Process," *Trans. Amer. Otol. Soc.*, 1886, 605; Green, J. O., "Diseases of the Brain in its Relation to Inflammations of the Ear," *Med. and Surg. Rep. of the Boston City Hospital*, 2d Ser., 1877; Amidon, "A Plea for More Heroic Surgical Interference in Affections of the Brain," *Med. News*, June 21, 1884; Brauns, "Successful Trephining in Cerebral Abscess following Otorrhœa," *Archiv f. Ohrenheilk.*, vol. xxix. p. 161; Lippincott, "Mastoiditis Interna Purulenta following Erysipelas," *Med. News*, Oct. 11, 1890; also *Trans. Amer. Otol. Soc.*, 1890; Arbuthnot-Lane, "The Treatment of Pyæmia consequent upon Disease of the Middle

Acute Catarrhal Otitis Media.

In order to make a choice of remedies rationally let us first consider the nature of the morbid processes with which we have to deal.

This morbid process is characterized by congestion, retardation of the outgoing current of venous blood in the inflamed area; by hyperæmia, determination of an abnormal amount of arterial blood to the arterioles of the region; by swelling of the mucous membrane and dryness of its surface; and by cessation of function of the ciliated epithelium of the mucous membrane of the Eustachian tube.

These changes are the same in this as in the other varieties of acute inflammation of the middle ear, and so far the indications for treatment are the same in all.

Now, however, if the disease does not subside, there follows a transformation, and the diseased process may proceed as a catarrhal, purulent, serous, croupous, gangrenous, or hæmorrhagic otitis media.

If the disease goes on as a simple catarrhal inflammation, after a variable period of time exudation takes place from the blood-vessels; the function of the mucous glands is resumed, but to an exaggerated degree; and the mucus so profusely secreted is not only thicker or thinner than normal, but acrid and irritating as well. The epithelial cells now undergo a change; the superficial ones desquamate, and new ones rapidly form to take their place. Those cast off are suspended in the discharged mucus. In some unusual cases the production of new epithelial cells is slower than the desquamation of the old ones, whence mucous ulcers are formed. Except in these cases the mucous membrane undergoes no structural change, and in case of sudden death from other cause no evidence of this disease will be found at the autopsy.

If the disease develop in a membrane previously healthy and without attendant constitutional disease or dyscrasia, entire recovery is the rule. If however, it develop in one previously affected with chronic catarrhal inflammation or in one whose vitality or function has been impaired by constitutional disease or dyscrasia, reflex irritation, nervous atony, extension of naso-pharyngeal disease, or other morbid condition, instead of a cessation of the inflammation with drainage and reabsorption of its products, and entire recovery, we may have, subsequently, partial thickening of the mucous membrane, with impaired or over-active function of the mucous glands—a "dry" or a "fluent

Ear unassociated with Thrombosis of the Lateral Sinus," *Brit. Med. Journ.*, June 28, 1890; Barclay, "Abscess of the Brain in its Relation to Inflammation of the Middle Ear," *Weekly Med. Review*, St. Louis, Nov. 28, 1891, p. 422; *ibid.*, *St. Louis Courier of Med.*, Oct. 1890, p. 176; *ibid.*, "Abscess of the Middle Ear," *Trans. Med. Soc. of the State of Missouri*, 1890, p. 203; also, *St. Louis Med. and Surg. Journ.*, Jan. 1891, p. 18; miscellaneous reports, *Trans. Amer. Otol. Soc.*, 1890 and 1891.

chronic catarrh," with exudation of plastic material which is subsequently transformed into new tissues.

The catarrhal process may instead be transformed into the purulent —a frequent occurrence in the debilitated—or into the croupous, hæmorrhagic, or, at worst, gangrenous form of inflammation of the affected membrane.

From the fact that this mucous membrane extends from the pharyngeal orifice of the Eustachian tube to the terminal pneumatic cells near the digastric fossa of the mastoid bone, covers all structures contained in the middle-ear tract, forms folds, bands, and septa irregularly disposed, which extend from or stretch between these structures and lie upon the periosteum, we can readily understand the discomfort, pain, and disability it may produce. For example: if, at the outset, from swelling of the mucous membrane the lumen of the Eustachian tube be closed, we would anticipate phenomena due to closure of the tympanum, to disturbance of the tension of the transmitting mechanism, hindrance of vibration of the membrana tympana, and checking of drainage. Rarely the disease may be accompanied by phenomena due to disturbance of neighboring parts, such as facial paralysis, toothache, or hemicrania, elevated temperature, constipation, agonizing pain, ear-cough, nausea, fever, etc.

Taking the worst case as a type, so that it may contain all the indications for treatment which are likely to be present, let us consider one having symptoms of sthenic constitutional disturbance—rapid tense pulse, high temperature, constipation, agonizing aural and meningeal neuralgia, nausea, etc.

In clinical features this disease at the outset is so nearly identical with acute purulent otitis media that a differential diagnosis between them at this early stage is not always possible, although we might naturally apprehend suppuration if the patient be unhealthy or debilitated. The indications for treatment, however, at this early stage are quite clear, and should be met promptly without regard to subsequent differentiation. From the fact, though, that suppuration may occur, which is essentially a condition of debility, prudence should warn us against the too vigorous or prolonged employment of those remedies —general bloodletting, for example—which depress the vital powers or abstract the useful resources of the body. It has been satisfactorily demonstrated, and quite recently again by Drs. Clarence J. Blake and Wm. S. Bryant,[1] that in the normal state the malleo-incudal nook from the rest of the tympanum, and the attic from the atrium of the tympanum, may, by reduplications and septa of mucous membrane, be wholly separated, or so nearly so that a slight swelling of the membrane from congestion would render it complete; and that the reduplications of

[1] *Archiv. Otolog.*, vol. xix. No. 4, pp. 209–232.

the mucous membrane in these compartments may be so extensive as to largely increase the secreting surface thereof, thus rendering probable the rapid and copious production of secretions during inflammation.

Moreover, the various smaller compartments of the malleo-incudal nook frequently have no outlet.[1]

Now, when the drumhead is intact there is no known method of determining the existence or non-existence of these peculiarities of conformation in the middle ear, whence the acute congestion of the middle ear may in any given case be a portent of a condition of imminent danger to life.[2]

These, then, being the characteristics of the morbid process with which we have to deal, let us turn our attention more directly to the therapeutic problem.

Having removed all palpable causes of the trouble, our attention must be directed to the relief of venous congestion, and we should influence the hepatic and portal venous system with such drugs as calomel and jalap, 10 grains of each at one dose, or 4 grains of calomel with 10 grains of powdered rhubarb taken at bed-time. In other cases we may give $\frac{1}{10}$ or $\frac{1}{6}$ grain of calomel with sodium bicarbonate every hour or half hour until 1 or 2 grains of calomel are taken, after which an active saline cathartic (not containing surplus acid, as the Seidlitz powder does) should be administered. By some it is thought best to bleed from neighboring parts, notably near the tragus, by animal or mechanial leeching. Again, we may try general venous bleeding from the median basilic or median cephalic vein. It is advisable to reduce general arterial tension, and of the various remedies which claim pre-eminence for this purpose, veratrum viride, through the action of its alkaloids jervine and veratroidine, is, for adults, *facile princeps*, "for jervine is a most powerful vaso-motor depressant, relaxing to a remarkable degree the walls of the blood-vessels everywhere; and not only does it do this, but at the same time so quiets the heart by an action over its muscle or ganglia as to reduce its force, thus preventing engorgement; while veratroidine, by stimulating the inhibitory nerves of the heart, also slows its beat, fills the ventricles, and allays excitement,"[3] and "so dilates the blood-paths that

[1] Politzer, "Pathologische Veränderungen in der Hammer-Ambossnische," *Die Anatomische und Histologische Zergliedering des Menschlichen Gehörorgans, etc.*, 1889, 86–88.

[2] Green, J. O., "Disease of the Brain in its Relation to Inflammations of the Ear," *Med. and Surg. Rep. of the Bost. City Hospital*, 2d Ser., 1887; Barclay, "Abscess of the Brain from Middle-Ear Disease," *St. Louis Courier of Medicine*, Oct., 1890, 176; *ibid.*, "Abscess of the Middle Ear," *St. Louis Med. and Surg. Journ.*, Jan., 1891, p. 18; also, *Trans. Mo. State Med. Soc.*, 1890, 203; *ibid.*, *Weekly Med. Rev.*, St. Louis, Nov. 28, 1891, p. 422.

[3] H. A. Hare, *A Textbook of Practical Therapeutics*, pp. 511, 512.

a man is bled into his own vessels"[1] from the inflamed area, without taking from him a single drop of good blood; all of which he will surely need in combating the disease after the acute stage has passed or if suppuration should supervene. For this reason veratum viride is far superior to general bloodletting, which might otherwise be a possible rival of veratrum viride or its congener aconite. Some one has termed aconite "the vegetable leech," and veratrum viride "the vegetable lancet." Veratrum viride is best administered in the tincture in doses of 1 drop every hour or half hour, or from 2 to 3 drops at longer intervals, until moisture of the skin, nausea, and slowing and softening of the pulse indicate that the drug has taken effect. If the patient vomit the early doses, we may give 5 to 10 drops of the deodorized tincture of opium a few moments before each dose until the veratrum viride shows its characteristic effects on the circulation. This is a safe as well as powerful remedy, for thus administered it will produce vomiting before poisoning fatally. For children, however, inasmuch as it is more apt to produce nausea and vomiting than its congener aconite, it is not as well suited as the latter. Aconite, though having no direct vaso-motor influence, nevertheless through its depressant action on the heart reduces arterial tension and also quiets nervous excitability. Aconite in small doses seems to possess a specific influence also for control of neuralgia of the trigeminus and other nerves about the head and face, and in both adults and children is usually soothing to the intense earache which accompanies acute otitis media. Aconite is best administered in the tincture, half a drop every hour or half hour until its circulatory effect is manifested.

Antimony, recommended by some, is too dangerous and depressing and its influence too prolonged. It may, however, be used in cases of extreme inflammation if the patient be very robust. It may be administered as tartar emetic half a grain every two hours, or as wine of antimony in doses of half a drachm until moisture of the skin, nausea, and the state of the pulse attest the influence of the medicine.

Chloral, which also has been recommended, is undesirable here because of its objectionable concomitant effects.

Pilocarpine, if used very early, may, however, be of service.

Counter-irritation should, if made, be not directly over the diseased area, but near it. For counter-irritation near the meatus we may use mustard, iodine, turpentine, capsicum, or the dry cup; and, as it seems better not to blister, we would prefer capsicum or the dry cup; the latter is best used (without scarification, of course) in the form of the "artificial" or "mechanical leech" invented by Dr. Gorham Bacon.[2]

[1] H. A. Hare, *A Textbook of Practical Therapeutics*, p. 326.

[2] Bacon, "On the Use of the Wet Cup in Place of the Leech in Certain Acute Diseases of the Ear," *N. Y. Med. Journ.*, Jan. 7, 1888.

Another and a very choice place for application of a counter-irritant is the posterior nares or naso-pharyngeal vault. Here we may apply with happy effect, by swabbing after the manner suggested by Dr. Albert H. Buck,[1] a solution of silver nitrate of the strength of 20 grains to the ounce of distilled water, or weaker if necessary, gradually strengthening the solution, or else a solution of iodine. While it would be manifestly contraindicated to apply a strong irritant solution to the inflamed mucous membrane of the Eustachian tube and middle ear, the procedure last advised, if followed as suggested, will, as a rule, act by reflex action very beneficially on the morbid process. Counter-irritation seems to have some influence as an analgesic also.

The diversion of blood to other parts may be accomplished sometimes by hot dry applications to the auricle and periauricular region, or at others by a hot foot-bath.

While cold might seem to promise benefit if used at the very inception of the inflammatory process, it is a dangerous agent in this condition, and had better not be employed.

Local depletion is very useful in some instances, and we may take blood from the vessels which drain the tympanum, it is said, by leeching on the outer or inner side of the tragus or near it; and, as the vessels here are sometimes congested, this procedure frequently gives relief. On the contrary, depletion may merely postpone the evil day and actually aggravate the intensity of the disease, for the procedures necessary to check the after-bleeding of leech-bites are frequently productive of considerable irritation. Cases are on record where a leech has managed to crawl unnoticed into the auditory canal.

Another and more direct method of local depletion of the inflamed area is the one thus described by Dr. Clarence J. Blake: "Free incision along the superior border of the membrana tympani, from the short process of the malleus backward, and deep enough to include the deeper layer of vessels going to form the inner manubrial plexus."[2] This operation is worthy of special consideration, and when indicated and skilfully performed it is particularly effective.

In cases where we do not wish to use local depletion by bleeding we may relieve the inflamed area by giving hydragogue cathartics, diuretics, and diaphoretics.

For instance, we may administer upon an empty stomach, and with the smallest amount of water necessary to swallowing the dose, $\frac{1}{6}$ grain of elaterium, combined with 1 grain of extract of hyoscyamus and 1 drop of oil of cinnamon. In other cases $\frac{1}{20}$ grain may be given of elaterin alone, or compound jalap powder, 20 to 30 grains, may be

[1] A. H. Buck, *Diagnosis and Treatment of Ear Diseases*, N. Y., 1880, pp. 166–169.

[2] Clarence J. Blake, *Archiv. Otol.*, Oct., 1890, p. 212.

used. To the dose of compound jalap powder 10 additional grains of bitartrate of potassium may be added to increase its efficiency.

A concentrated solution of magnesium sulphate, in the dose of 1 table-spoonful given in the morning on an empty stomach and repeated if necessary, is an excellent hydragogue cathartic. The *modus operandi* of these remedies has been very happily explained as follows: "All these remedies relieve dropsy by causing so great an outpouring of liquid from the blood-vessels of the body that the liquids in the tissues are taken up by the depleted blood-vessels to replace the loss through the action of the purgative."

"In other words, these purgatives render the alkalinity of the blood greater by concentration, and absorption of fluid occurs by reason of the following physiological and physical facts."

"As is well known to every physiologist, the passage of a salt solution of less than seven-tenths of 1 per cent. through a blood-vessel causes an abstraction of salts by the circulatory fluid from the tissues, in order that the amount of salts in the vessels and tissues may be identical. At the same time the tissues become infiltrated with liquid. On the other hand, if the solution be stronger than the normal, the liquid leaves the tissues to enter the vessels, and the tissues in consequence shrink."[1]

If these remedies, diuretics or diaphoretics, are not desirable, acetate of ammonium, pilocarpine, and other active diaphoretics should be thought of.

For the purpose of reducing the plasticity of the blood, checking fibrinous exudation, and preventing the formation of pus we may employ mercury, which lessens the quantity of fibrin in the blood, softens plastic exudates, and thus acts as a check upon exudation and the organization of new tissue. It may be used in the form of calomel, blue pill, mercury with chalk (or, in finer trituration, with sugar of milk), as corrosive sublimate or as the biniodide, the ointment, or oleate (10 per cent.)—these last two externally of course, and usually about the ear. Its use is contraindicated at once if the disease should assume the serous form, as in that condition it would only increase the characteristic feature of the disease. If periostitis of the wall of the meatus or of the external or internal surface of the mastoid is threatened, local inunctions of the ointment or oleate around the auricle and about and within the meatus is often serviceable. An instructive instance of the beneficial action of mercury in such a condition has been published by Dr. Albert H. Buck,[2] and Wilde, Toynbee, Theobald, Sexton, and many others testify to its unquestionable merits under these circumstances. Besides the mer-

[1] H. A. Hare, *A Textbook of Practical Therapeutics*, under "Dropsy," p. 402.

[2] A. H. Buck, *Diagnosis and Treatment of Ear Diseases*, N. Y., 1880, p. 307.

curials, the preparations containing iodine may be used, and they are chiefly serviceable in scrofulous or debilitated constitutions. Calx sulphurata may be used to check the formation of pus, and may be given in a dose as small as $\frac{1}{20}$ grain every hour or two. In the large doses it is apt to disturb the digestive organs and kidneys, and therefore should not be so administered.[1]

Pyrophosphate of sodium in doses of 10 to 20 grains may be given as antisuppurative every two or three hours, according to the urgency of the symptoms, with satisfactory results. It should be administered dissolved in water in the proportion of 40 grains to the ounce.[2]

Opium seems to have some claim to recognition as an agent for fulfilment of this indication, and may be used in the form of the deodorized tincture, extract, or wine. Morphine and the other alkaloids, while excellent as anodynes, are inferior to opium as antiphlogistics.

If over-secretion threaten, we may employ small doses of the preparations of belladonna, atropine, and opium, or, as advised by some, morphine. The addition to these of a very small quantity of quinine has been pronounced desirable by some. Tonics, especially strychnine and ferruginous compounds, are very useful.

If the secretion be of a mucous rather than serous nature, and not sufficiently abundant to over-distend the tympanum, we may possibly secure its removal by giving ammonium chloride in doses, to adults, of 10 to 20 grains well diluted in water four times a day;[3] to children, 5 to 8 grains, with a little syrup of tolu.

If, notwithstanding treatment, secretions continue to form rapidly, and there be evidence of danger from their presence, the case presents a surgical feature, and therefore, without waiting for distinct bulging of the membrana vibrans or membrana flaccida tympani, the aid of surgical interference should be invoked at once. The operation of compressing against the drumhead the air of the meatus, with a view to pressing in that membrane and so forcing the surplus secretions through the Eustachian tube, has been tried and found sufficient in some cases to relieve over-distension of the middle ear by secretions.[4]

[1] Compare "Report of Committee on Restoratives N. Y. Co. Med. Soc.," and discussion, *Med. Record*, Apr. 29, 1882; Atkinson, F. H., "Suppuration, etc.," *Med. Record*, May 13, 1882; *Medical Gazette*, N. Y., May 13, 1882; Cane, *Lancet*, Feb., 1878, p. 215; H. G. Piffard, *Journ. Cutan. and Vener. Dis.*, Jan., 1883; *Trans. Amer. Dermatol. Assoc.*, Aug. 30, 1882; Sexton, S., "Employment of Calcium Sulphide in the Treatment of Inflammatory and Suppurative Aural Disease," *Am. Journ. Otol.*, 1882, iv.; ibid., *Amer. Journ. Otol.*, Jan., 1879; Snell, *Practitioner*, Jan., 1882; *N. Y. Med. Journ.*, May, 1880.

[2] Samuel Theobald, "Use of Constitutional Remedies in Treatment of Ear Diseases," *Medical News*, Feb. 4 and 18, 1882.

[3] Samuel Theobald, *op. cit.*

[4] Samuel Sexton, "Earache, or Catarrhal Inflammation of the Middle Ear," *Med. Record*, Jan. 13, 1877.

Again, it has been found possible to remove surplus secretions from the middle-ear tract through the Eustachian tube with a flexible Eustachian catheter and so-called "suction" syringe.[1]

Should fever be a pressing symptom, and if the remedies above recommended for arterial relaxation and cardiac depression have proved inefficient, we may give antipyrine in doses of 5 to 10 grains or acetanilid in 4-grain doses in alcohol. Although these drugs have no curative influence whatever upon the process that produces the abnormal temperature, they are nevertheless advisable. They have an influence as analgesics also if given in small doses. The peculiar remedial properties of these drugs have been well stated and compared by many writers, and consequently need not be discussed here, and the reader is referred to the latest work of this character.[2]

For the relief of pain and systemic disturbances we should remove the patient from all sources of annoyance, as by loud sounds, enjoining perfect rest and relief from work and worry of any kind whatever.

If the disease develops in a young child not "teething," and is attended by intense earache, pulsatilla in the form of the tincture, in doses of a drop or a fraction of a drop every hour or half hour, may give prompt relief. Locally we may apply to the drumhead and the deeper parts of the meatus a small quantity of an ointment composed of equal parts of vaseline and ointment of belladonna, or else a few drops of a 5-grain-to-the-ounce solution of sulphate of atropine.[3] A well-warmed solution of atropine sulphate of the strength of 2 grains to an ounce of water, instilled into the meatus, is still a favorite remedy with many. If, however, there be any solution of continuity within the meatus, or if rupture of the drumhead should unexpectedly occur while such an atropine solution is within the meatus, dangerous poisoning may result from its absorption.

The employment of any watery or moist continuous application within the ear is to be discouraged, inasmuch as such favors maceration, ulceration, desquamation, and often suppuration.

Small and not narcotic doses of opium, as in Dover's powder or in Gregory's syrup, may also be given at short intervals to relieve the pain.

In children who are teething the earache and restlessness can usually be controlled by frequent doses of infusion of chamomile-flowers, after the manner of Ringer already quoted.

In adults the intense pain of acute otitis media can usually be relieved by the administration of aconite, as the tincture of the root,

[1] Samuel Sexton, *The Ear and its Diseases*, 1888, p. 238; also, *Lancet*, Oct. 18, 1884; and *Trans. Amer. Otol. Soc.*, 1881.

[2] H. A. Hare, *Prize Essay on Antipyretics*, Phila., 1891.

[3] Samuel Sexton, "Earache in Children," *Med. Record*, May 5, 1883.

if given in doses of a fraction of a drop, well diluted in water, every hour or half hour as required.

Hot, dry applications, such as a bag of hot water, sand, or hops, or the Japanese "pocket-stove," so called, applied to the auricle and side of the head, may relieve the pain.

It should not be forgotten that an intense aural neuralgia may be a manifestation of the rheumatic or gouty diathesis or of chlorosis, anæmia, malarial poisoning, syphilis, or morbid states of the general system, and that it may be due as well to abnormal local mechanical conditions. If any of these be recognized, their influence should be counteracted at once.

Since pain should cease on proper treatment, its persistence thereafter should be looked upon as evidence of unfavorable progress of the case, and, unless manifestly contraindicated, surgical aid should be sought at once. The majority of cases where this is called for are those where the nidus of the inflammation is in the malleo-incudal nook of the outer wall of the tympanic attic; and it is here that we are so often rewarded with brilliant results from incision along the posterior fold of the drumhead, after the manner of Dr. Blake, already quoted.

The occurrence of rigors, sudden increase of fever, nausea or vomiting, frequent or continuous vertigo, facial paralysis, with intense pain, with or without physical evidence of pent-up secretions, especially if the patient be a young or an aged person or constitutionally debilitated or diseased, should suggest active surgical interference at once, and an operation will naturally place the case under the indications for treatment of acute purulent otitis media.

Tonic treatment of these cases during convalescence is very necessary, and this end should be accomplished by first giving attention to the surroundings of the patient. He should have plenty of fresh air, sunlight, cheerful companionship, entertainment, and diversion, be out of doors, and take with regularity a moderate amount of muscular exercise. Change of scene and climate renders a journey or voyage beneficial. We should see that the patient receives wholesome, appetizing, and nourishing food, and in addition ferruginous preparations, mineral or vegetable tonics, the mineral acids, or cod-liver oil. In conditions of depression we may give citrate of iron and strychnine, light wines, the various combinations of egg, milk, sherry, brandy, and wine, or other stimulants, according to the effect desired.

For the removal of the products of inflammation we should select remedies which are reputed to have power or tendency to liquefy exudates, to induce gradual or fatty degeneration thereof, or to promote their reabsorption or expulsion from the tissues. Of the first, the preparations of mercury are the best and may be employed as advised above.

Should the acute inflammation have attacked an ear previously the seat of chronic catarrhal inflammation, the biniodide of mercury, in doses at first of $\frac{1}{32}$ grain after meals, with potassic iodide, in the proportion of 2 grains of the latter to 1 of the former to render it freely soluble in water,[1] or if the iodine be not borne well, bichloride of mercury in doses at first of $\frac{1}{64}$ grain or less, three times a day, will be found particularly effective. In the robust we may give the salines or hydragogue cathartics. In the rheumatic we may combine the use of colchicum with the iodides. In other cases the preparations of iodine are sometimes effective.

Acute Purulent Otitis Media.

Acute purulent is a modified form of acute catarrhal otitis media, the changes in both being primarily similar, except that in the former we find pus-cells produced both on the surface and in the substance of the membrane, so that the discharge from and the stroma of the membrane are more or less filled with them. The amount of pus produced and cast off may vary greatly in the different cases; in some being scanty, so that we cannot distinguish between this disease and acute catarrhal otitis media; in others so abundant that purulent discharge and infiltration are unmistakable. Moreover, in the latter cases the inflammation is usually more severe and the constitutional disturbance greater. In tuberculosis, however, this disease may sometimes become established wholly without the patient's knowledge.

There may be a transformation of acute catarrhal into acute purulent otitis media, or *vice versâ*, the only difference between them being in the production and non-production of pus.

From the fact that in clinical features, as well as in physical phenomena, acute catarrhal and acute purulent otitis media may so closely resemble each other that a differential diagnosis is impossible, and that the underlying process is in the early stage very similar, the indications for treatment so closely resemble each other in both that the treatment advised for acute catarrhal otitis media will serve as well for acute purulent otitis media. It is only when the latter presents a surgical feature that the indications differ. Where the presence of over-secretions or pus seems undoubted the general indications are as follows: to liberate pent-up secretions or pus, render the exposed cavity aseptic, urge the parts to a healthy activity and remove the products of inflammation, prevent mechanical disability, check overgrowth of neoplastic tissue, and induce closure of any abnormal opening.

For the purpose of liberating pent-up secretions or pus we may resort to several measures. One is the operation of compressing the air of the meatus against the drumhead, thus forcing secretions through

[1] Theobald, *op. cit.*

the Eustachian tube. Another is the removal of surplus secretions from the middle ear through the Eustachian tube with a flexible Eustachian catheter and so-called "suction" syringe. Still another, the incision through or paracentesis of the drumhead, respecting the site of which it may be said, "if the *nidus* of the abscess is in the malleo-incudal niche of the attic of the tympanum, cut freely to it through the membrana flaccida. If in the atrium also or alone, operate as well or only upon the membrana vibrans at whatever spot thereof bulges most, or if its bulging be uniform operate at the posterior inferior quadrant." [1]

The use of the aspirator where the secretion is confined to the atrium of the tympanum has been recommended by some authors.

In case the condition is not ameliorated by these procedures and if grave symptoms develop, one should proceed without delay under antiseptic precautions to remove part or all of the membrana tympani, the malleus and incus, penetrate to the petro-mastoid antrum through the cortex of the mastoid process, perforate the auditory plate to the scute of the antrum and attic, or to perform any other operation as indicated, surgically, in the case.

If in order to remove pent-up secretions or pus it has been found necessary to open the middle-ear tract, the next indication will be to render the exposed cavity aseptic.

There seems to prevail a difference of opinion as to whether, in the treatment of the otorrhœa of acute purulent otitis media, drugs had better be used in solid or in liquid form. The fact is, that at different stages of the same aural disease the same remedy may be indicated in different forms, but the manner of using it will largely determine its beneficial or injurious effect. For example, boric acid, which in acute purulent otitis media, at the early stage of profuse secretion, had better be used in solution or else in the form of fine powder insufflated as an impalpable dust in very small quantities, may be freely insufflated as the discharge begins to diminish; while, as the discharge ceases at the mouth of the wound of the drumhead, if used at all it should be employed very sparingly and insufflated in the very finest dust, lest by drying the edge of the perforation growth be checked there and restitution of the lost membrane be prevented. Care should be taken with all drugs used in powdered form in the stage of profuse secretion, lest they check drainage. If drugs are used in solution, the liquid may macerate the tissues or irritate or prevent the closure of the perforation. Forcible syringing of the ear is not to be attempted.

Boric acid may be used as a dry, impalpable powder, in solution in the proportion of 20 grains to the ounce of water, or up to saturation

[1] R. Barclay, "Abscess of the Middle Ear," *St. Louis Med. and Surg. Journ.*, Jan., 1891, p. 20; also *Trans. Med. Assoc. of State of Mo.*, 1890, p. 203.

with water or alcohol. Carbolized boro-glyceride[1] may be used, or corrosive-sublimate solution, of a strength of 1 : 5000 or weaker, prepared after the following convenient prescription :

℞. Hydrarg. chlorid. corrosiv., gr. viij ;
Acid. tartaric., gr. 320 ;
Aq. destillat., q. s. ad f℥j.—M.
Sig. Concentrated solution of bichloride of mercury, 3ℳ to 4 ounces of water ; make 1 : 5000 solution of corrosive sublimate.

Or, if less tartaric acid be preferred,

℞. Hydrarg. chlorid. corrosiv., gr. iij ;
Acid. tartaric., gr. xv ;
Aq. destillat., q. s. ad Oij.—M.
Sig. 1 : 5000 bichloride-of-mercury solution.

There is a compressed tablet, containing 1¾ grains of corrosive sublimate with citric acid 87–100 grains, in the market, put up by Parke, Davis & Co., Detroit, Mich., which tablet with water ¼ pint gives 1 : 1000 ; ½ pint, 1 : 2000 ; 1 pint, 1 : 4000 ; 20 ounces, 1 : 5000, solution of bichloride, which can be freshly prepared for use at a moment's notice. This is a convenience, especially as the bichloride solutions do not keep well.

Carbolic acid may be used in about 40 per cent. solution with water or with equal parts of glycerin and water. It must not be forgotten that glycerin is hygroscopic and acts as a depletant. The solution of carbolic acid should, if possible, be made with the water at boiling temperature, and be prepared some time before using, to permit the phenol to become thoroughly dissolved.

Iodoform may be used by insufflation. Its odor is offensive and it may form hard impactions, while the absorption of secretions attributed to it may be secured with other drugs which have not its objectionable features—with boric acid, for example. If a solution is desired for this purpose, iodoform may be dissolved in alcohol or linseed oil. It is said by certain authorities to be fatal to the tubercle bacillus, and hence is said to be very serviceable in otitis media purulenta of tuberculous origin. It may be used pure, or triturated with boric acid, 1 part to 7, after the formula of Dr. C. H. Burnett.

Kreolin or creolin, a coal-tar product, is very efficient, forms a milky emulsion with water, and leaves an oily antiseptic coating behind it wherever used. In the ear a solution of 1 drop of creolin

[1] Samuel Sexton, "On Acidum Boracicum and Calendula Officinalis, and their Uses in Aural Disease," *Med. Record*, Dec. 31, 1881.

to the ounce of warm water may be used, or if this causes discomfort it may be still further diluted.

Peroxide of hydrogen, in the 15-volume solution, may be used undiluted, or diluted according to the amount of pus and according to the intensity of the disease; for the more acute the stage of inflammation the more we must dilute the hydrogen peroxide.[1] It is essential that the genuine article be used, and care must be exercised in selecting a particular brand. The writer has found that of Mallinckrodt Brothers' manufacture satisfactory. For test and description of commercial and market medicinal brands of peroxide of hydrogen consult the recent essay of Dr. Wallian.[2]

Salicylic acid has been recommended as an aural antiseptic. It is irritating to mucous membranes, and, although very serviceable in the chronic, should not be used in the acute variety of purulent otitis media.

Methylaniline, methyl violet, the "pyoktanin cœruleum" of Merck of Darmstadt, in solution of 1 : 5000 up to 1 : 2000 of water or alcohol, has in the hands of some proved of service as an antisuppurative, while others have pronounced it inert or even irritating.[3]

Permanganate of potassium is an antiseptic and deodorant by virtue of its oxygen, which is liberated when brought in contact with moisture. It may be used here upon the same principle and under the same conditions of variation as hydrogen peroxide, in solution with distilled water 20 grains to the pint. If there be decomposition of the secretions, it is particularly useful and second only to hydrogen peroxide.

Aristol, iodol, resorcin, and many other of the coal-tar derivatives might be discussed at length; they are to some extent *sub judice*, and the remedies mentioned above seem sufficient to meet the indication in any case.

For the production of a healthy activity in the tissues we employ astringents in weak solution, the mineral astringents by preference, and notably the nitrate of silver. These drugs are not to be used during the sthenic stage of the disease, but later if the morbid process manifests a tendency to lapse into chronicity.

[1] Compare Leeds, "Peroxide of Hydrogen and Ozone," *Journ. Amer. Chem. Soc.*, N. Y., 1880–81, ii. 34, 147; ibid., "The Literature of Ozone and Peroxide of Hydrogen," *Chem. News*, Lond., 1884, i. 215–218; Richardson, "Further Researches on the Therapeutic Properties of Peroxide of Hydrogen," *Trans. M. Soc.*, London, 1862, ii. 51–53.

[2] S. S. Wallian, "In Re Hydrogen Dioxide." *Medical News*, Phila., Jan. 30, 1892.

[3] Riesmeyer, "Observations in the Treatment of Surgical Cases with Pyoktanin," *St. Louis Courier of Med.*, Nov., 1890, 212; R. Barclay, "Use of Pyoktanin in Ear Diseases," *Medical Record*, Aug. 23, 1890; ibid., "Uses of Pyoktanin in Ear Diseases," *St. Louis Courier of Med.*, Nov., 1890; Alt, "Experiences with Pyoktanin in Ophthalmological and Otological Practice," *Am. Journ. Ophthalmol.*, Oct., 1890, 314.

Calendula officinalis, as either the alcoholic tincture or non-alcoholic succus if preferred in the fluid form, or equal parts by weight of the tincture and of boric acid evaporated to dryness if the dry or powdered form is desired, will stimulate the diseased membrane to healthy activity.[1]

Hydrogen peroxide, aside from its pus-destroying properties, is also useful. Its oxygen brings about a healthy activity in the diseased membrane.

To liquefy decomposing tissue, muco-pus, lymph-coagula, and fibrinous bands we may use one of the digestive ferments, notably pepsin or extract of pancreas, as suggested by Dr. Robert T. Morris.[2] Under the influence of an acidulated solution of pepsin moist fibrin first swells, whereas under that of a solution of pancreatic ferment it dissolves without swelling or becoming gelatinous. The latter process, therefore, seems the more desirable one in aural therapeutics. The preparations used by Dr. Morris in his experiments were those manufactured by Messrs. Fairchild Bros. & Foster. The solutions should be freshly prepared for use as follows: Use for the vehicle distilled water heated to a temperature which can be borne by the hand (115° to 130° F.). If pepsin be used, acidulate the hot water with hydrochloric acid to $\frac{1}{2}$–1 per cent., and then add pepsin 10 per cent., shaking it or rubbing it in a mortar. If extract of pancreas be used, add bicarbonate of sodium 1 grain to each ounce of hot water to render it alkaline; then add extract of pancreas 15 grains to each ounce of the mixture. In using pepsin the glyceritum pepticum may be employed. It is soluble, convenient, and efficient, and from it a solution of any strength can be made instantly. It may be used in acidulated hot water in strength of 1 drachm to each ounce of the mixture.

The fluids must be applied several times to the diseased cavity, and then syringed out with very warm water; after which the diseased cavity should be flushed out with peroxide of hydrogen and an antiseptic dressing applied to the wound of the drumhead.

We should keep the parts movable and moving after the acute stage has passed and convalescence is fully established. Gentle occasional inflation of the middle ear by Valsalva's or Politzer's method, the use of the bulb, tube, and nozzle for rarefaction and condensation of the air in the meatus to increase and decrease the aërial pressure upon the outer surface of the drumhead, and the use of Maloney's otophone,[3] seem to be of service in retaining mobility,

[1] Samuel Sexton, "On Acidum Boracicum and Calendula Officinalis, and their Uses in Aural Disease," *Medical Record*, Dec. 31, 1881.

[2] Morris, "The Action of Trypsin, Pancreatic Extract, and Pepsin upon Sloughs, Coagula, and Muco-pus," *N. Y. Med. Journ.*, April 11, 1891.

[3] Maloney, "The Otophone: its History, with a Description of its Various Forms, etc.," *Archiv. Otol.*, vol. xvi. No. 3; also in German, *Zeitschr. f. Ohrenheilk.*, Bd. xix. Heft 1.

after the manner of passive motion or massage, favoring the absorption from the tissues of the products of inflammation.

In checking overgrowth of neoplastic tissue we have to deal principally with exuberant granulation tissue and polypoid growth, and we may make frequent instillations of alcohol, which tends to desiccate the growth and to act as an astringent upon its blood-vessels.

Concentrated lactic acid is sometimes of service in promoting reabsorption of redundant neoplastic tissue.

Nitrate of silver in saturated solution is an excellent superficial caustic. To obviate the pain otherwise caused by the application of a caustic, cocaine muriate, 4 to 10 per cent. solution, should first be applied.

Nitric acid, chromic acid, salicylic acid, ether, and certain other reagents recommended by good authorities seem too searching, severe, and irritating in their effects unless used with the greatest prudence and skill.

When we wish to induce closure of the abnormal opening we should be careful, if using the "wet method" of treatment, lest the force of the fluid injected or its too frequent introduction interfere with the reparative growth of the drumhead: if using the "dry method," lest our powders too profusely insufflated dry up the edges of the perforation and thus check the reproduction of the membrane. As the discharge is about to cease pouring from the perforation, the boric acid, pyoktanin, or other remedy used may be applied on a loosely-rolled absorbent cotton-wool wad of sufficient size to lie easily against the entire rim of the perforation. The wad will absorb surplus discharges, while by its light contact it will stimulate growth of the membrane at the edge of the perforation. If the discharge has ceased entirely and the edges of the perforation are raw, the perforation should be closed with some light covering or splint, as in the procedure advised by Dr. C. J. Blake, which is this: A paper disk of sufficient size just to overlap the perforation should be moistened on one side, and then be carried on a wet cotton-wool brush at the tip of a fine probe to the perforation, to which it should be applied so as to overlap its edges. The moisture makes it stick until serum completes the gluing process, as it were. This Blake disk will shield the inflamed mucous membrane, stimulate growth at the edge of the perforation, and splint the reproduced membrane while forming, upon the plane of the original lost membrane, so that it cannot "bulge," "sag," or become manometric, patch the defective sound sail or drumhead, restore the resonance of the tympanum, and in other ways act beneficially.[1]

[1] Blake, "Application of Paper Dressings in Treatment of Perforations of the Membrana Tympani," *Report of First Congress of the Internat. Otolog. Society*, Sept., 1876, p. 125; Barclay, "The Use of the Paper Disk; Case-Histories," *Trans. Amer. Otol. Soc.*, 1890, p. 564; *Boston Med. and Surg. Journ.*, 1890, cxxiii. 113, abstracted *Med. Record*, July 26, 1890; Prout, "On the Use of Adhesive-Rubber Plaster in Cases of Perforation of the Membrana Tympani," *Trans. Amer. Otol. Soc.*, 1886, 686.

As the dermoid coat of the drumhead grows it replaces the lost membrane and carries the paper disk with it outward to the wall of the canal, whence it is either artificially removed or falls out.[1]

If, however, the edge of the perforation become cicatricial or dry, it should be refreshed by application of a cotton-wool brush wet with a solution of nitrate of silver, 20 grains to the ounce of distilled water, or stronger if required.

There are numerous and various devices for inducing closure of a perforation of the drumhead which cannot be discussed here, as they lie rather within the province of aural surgery.[2]

After the disk or splint is applied, and when the new membrane is approaching completion, all possible care should be taken to avoid interference with tympanic air-supply and pressure.

Croupous or Diphtheritic Otitis Media.

According to certain eminent authorities, the terms croupous and diphtheritic are not identical in significance, and therefore may not be used indiscriminately; the former, "croupous," "relating to croup," to a process "accompanied with fibrinous exudation on the surface, which does not penetrate below the epithelium, and can be easily removed;" the latter, "diphtheritic," "relating to diphtheria," or to a process where "there is a fibrinous exudation on the surface, combined with necrosis of the epithelium and the tissue immediately beneath it."[3]

"We are now, it would seem, justified . . . . in saying that the name 'diphtheria,' or at least 'primary diphtheria,' should be applied, and exclusively applied, to that acute infectious disease usually associated with a pseudo-membranous inflammation of the mucous membranes which is primarily caused by the bacillus called bacillus diphtheriæ of Loeffler."[4] There are, however, "other forms of acute infectious diseases . . . . associated with a pseudo-membranous inflammation of the mucous membranes, and caused by wholly different germs"—notably that resembling the streptococcus pyogenes and streptococcus erysipelas, called the streptococcus of Prudden.[5]

Popularly, however, when one speaks of "croupous or diphtheritic

[1] Blake, "The Progressive Growth of the Dermoid Coat of the Membrana Tympani," *Am. Journ. Otol.*, 1882, iv. 266.

[2] Green, J. O., "Restoration of the Membrana Tympani after its almost Complete Destruction by Chronic Inflammation," *Boston Med. and Surg. Journ.*, 1870, lxxxiii. 347. The reader specially interested in this subject will find numerous topical references to its literature on pp. 99, 100, and 101 of vol. ix. of the *Index-Catalogue of the Library of the Surgeon-General's Office, U. S. A.*

[3] Billings, *Nat. Med. Dictionary*, vol. i. pp. 351 and 400.

[4] T. Mitchell Prudden, "Studies on the Etiology of Diphtheria, second series," *Med. Record*, April 18, 1891.

[5] Ibid., *loc. cit.*, and "On the Etiology of Diphtheria," *Amer. Journ. Med. Sciences*, May, 1889.

otitis media" it is intended to convey the idea of an inflammation of the middle ear characterized as follows:

The congestion is usually greater in extent and intensity, and the swelling of the mucous membrane more exaggerated, than in catarrhal otitis media. The surface of the membrane is covered with a stratum called the false membrane, composed principally of fibrin, pus, epithelial cells, and, usually, bacteria. The fibrin is coagulated in various forms, and in quantity varies as the degree of intensity of the inflammatory process, sometimes forming a layer so thin as to be invisible to the unassisted eye. The pus and epithelial cells vary in form, size, and disposition, and undergo different kinds and degrees of degeneration. The bacteria also vary in amount and in kind.

Moreover, the substance of the membrane is infiltrated with fibrin and pus, the degree of infiltration and the quantity of fibrin and pus varying with the degree of severity of the inflammation. Sometimes the genesis of new products is so great as to cause, practically, a compression and consequent emptying of, or else absolute stasis in, certain local blood-vessels, and ulcers result. In some cases the ulceration may be very extensive as well as deep, involving the underlying tissues.

The popular delusion that diphtheria and the diphtheritic process, as such, but rarely attack the ear is contraindicated by the statement of competent observers, who have found them as both primary and secondary diseases.[1]

This aural disease is usually an intercurrent feature of diphtheria, and is, as a rule, comparatively painless, showing a marked tendency to assume a chronic form of inflammation, and apt to produce very

[1] Barclay, "Diphtheria of the Ear, with Bibliographical References to Reported Cases," *St. Louis Weekly Med. Review*, Nov. 12, 1887; Moos, S., *Archiv. Ophthal. and Otol.*, N. Y., 1861, vol. i. No. 2, pp. 634, *et seq.*, trans. by Clarence J. Blake, M. D., Boston, Mass.; compare *Monatsschr. f. Ohrenh.*, vol. ii. No. 10; Politzer, *Treatise on Diseases of the Ear*, Cassell's translation, Philadelphia, 1883, p. 604; Wilde, *Practical Observations on Aural Surgery*, Lond., 1853, pp. 231, 232; *ibid.*, Amer. ed., Phila., 1853, p. 194; Bezold, *Virchow's Archiv*, vol. lxx.; ibid., *Archiv f. Ohrenh.*, vol. xiv., 1878, p. 66; Callan, *Med. Rec.*, New York, March 27, 1875; Jacobson, *Archiv f. Ohrenh.*, vol, xix., 1882, p. 37; Jacobi, A., *Treatise on Diphtheria*, 1880, pp. 74, 75; Burnett, *Treatise on the Ear*, Phila., 1884, p. 461; Cerrutti, *Gior. d. r. Accad. di Med. di Torino*, 1875, xxxviii. pp. 385–395; Boke, *Wien. Med. Halle*, 1864, v. 379; Burkhardt-Merian, *Samml. klin. Vortr. von Volkman*, No. 182; Wendt; see also *Thierfelder Atlas Histol. Anatom.*, tab. 1; Wreden, *Monatsschr. f. Ohrenh.*, 1868, No. 10; Politzer, *loc. cit.*, p. 387; ibid., *loc. cit.*, p. 409; Roosa, *Practical Treatise on Diseases of the Ear*, 1873, p. 353; Buck, *Diagnosis and Treatment of Diseases of the Ear*, N. Y., 1880, p. 203, *et seq.*; Mulhall, *Records of St. Louis Med. Society*, Oct. 8, 1887; *The Classification and Treatment of over Two Thousand Consecutive Cases of Ear Diseases at Dr. Sexton's Aural Clinic, New York Eye and Ear Infirmary*, by Samuel Sexton, M. D., Aural Surgeon, W. A. Bartlett, M. D., and Robert Barclay, M. D., Assistant Surgeons, Detroit, Mich., 1886, pp. 82, 86, 89, 94, and 95; Loring, *Amer. Journ. Otol.*, vol. iii. part 2, p. 126; Wolf, *Archiv. Otol.*, N. Y., vol. xiv. p. 140.

widespread destruction, with necrosis and burrowing to neighboring parts. During an attack of diphtheria the ear should be carefully examined at short intervals, and if the disease is found in this region remedial measures should be promptly and vigorously pushed.

Violent syringing of the fauces and nares for the local process therein should be discountenanced. Nasal syringing, anterior or posterior, in diphtheria should be done with gentleness, prudence, and care, lest the materies morbi and injected fluid be forced into the Eustachian tube and thence into the middle ear. For the aural invasion aconite may be given in the early or congestive stage, and some preparation of mercury to diminish the plasticity of the blood and limit the fibrinous exudate. For example, corrosive sublimate, $\frac{1}{10}$ to $\frac{1}{2}$ grain, may be given, or calomel $\frac{1}{6}$ to $\frac{1}{4}$ grain, every hour until the green, frothy stools show that the system is becoming impressed by the drug. If the aural trouble should not disappear under this treatment, and if the drumhead show unquestionable evidence of an intense inflammation within the tympanum, even if the patient does not complain of intense aural pain or discomfort, the prudent procedure is the surgical one of making either a straight, a T-, or a V-shaped incision through the posterior fold of the drumhead and into the attic of the tympanum. These openings should be very freely made, and sufficiently large to favor the escape of the products of inflammation and to permit of direct medication. The false membrane and discharges should be removed by instrumental means if other resources fail, lest there be burrowing of the disease to neighboring parts. After aspiration our aim should be to maintain free drainage, cleanliness, antisepsis, and the dissolution of the false membrane. It should be borne in mind that this is a destructive process, and at best will eventuate in purulent otitis media. (For choice of antiseptics see the article on Otitis Purulenta.) Of the remedies which promise a dissolution of the false membrane, we may hope for success with lime-water; lactic acid, 30 grains to each ounce of the solution; a solution of one of the digestive ferments, trypsin, pepsin, extract of pancreas, or peroxide of hydrogen. Aside from this special treatment for dissolution of the false membrane, the aural treatment conjoined therewith should be that recommended for acute purulent otitis media. The general condition of the patient is of paramount importance, and the reader should consult the articles on Scarlet Fever and Diphtheria in Vol. II. of this SYSTEM.

GANGRENOUS OTITIS MEDIA.

This may occur as a modification of catarrhal, purulent, or croupous otitis media where the congestion is intense and complete stagnation ensues, when a portion of the membrane dies and remains undetached and decomposed, or else sloughs or becomes the nidus of bacteria and

putrefaction. The extent of tissue involved may be either slight or very great.

According to the highest authorities, there seem to be epidemics of this variety of middle-ear disease, the reason for which is as yet undetermined. It seems, however, that gangrene is apt to occur when local or constitutional debility is present, by which the resisting power of the tissues is lessened; especially so in persons "whose tissues have become degenerate in consequence of old age, of defective food, or of other materials of life or through habitual intemperance."[1]

The indications for treatment of this variety of inflammation seem to be to remove the cause by reducing the intensity of the local inflammation, and thus arrest the gangrene; to support the system during the process of separation of the sloughs and dead tissues; to quiet nervous irritability; to remove the products of inflammation,—all of which measures are described under Acute Purulent Otitis Media.

Serous Otitis Media.

This peculiar variety of middle-ear disease is commonly seen in persons of advanced years, and the serous effusion which characterizes it is analogous in most respects to that occurring elsewhere in the body where serous membranes are found.

The indications for treatment, briefly stated, are to give attention to the general diathesis, which is often gouty or rheumatic, and to induce reabsorption of the fluid in the tissues by hydragogue catharsis.

In this variety of otitis media mercury is contraindicated. Counter-irritation may be of service in assisting the process of reabsorption.

Hæmorrhagic Otitis Media.

By this term we mean a variety of middle-ear disease whose chief characteristic is a hæmorrhagic exudation into the tympanum. This may be, and usually is, attended by rupture of the membrana tympani, with escape of blood from the meatus. Sometimes vent is given through the Eustachian tube, thus preserving the drumhead intact. The fluid poured out is usually hæmorrhagic, but it may be serosanguinolent.

Hæmorrhage into the tympanum may result from rupture of the walls of blood-vessels which are over-distended in the intense congestion of acute otitis media; it may result from inflammatory erosion of the walls of blood-vessels from traumatism of the middle-ear tract or with new growths, such as polypus or cancer.

True hæmorrhagic otitis media is usually an attendant phenomenon of Bright's disease or of diabetes. It is encountered also in the aged whose blood-vessels have undergone vital and physical degeneration;

[1] Erichsen, citing Paget, *op. cit.*, vol. ii. p. 651.

and in persons of a hæmophilial tendency by heredity or through influence of certain constitutional diseases.

The indications for treatment of hæmorrhage into the middle ear, however occurring, are, first, to check the hæmorrhage with local styptics, tamponing, ligature of the main vessels if necessary, and to render the parts aseptic. Locally with styptics we aim to produce constringing of the tissues, coagulation of fibrin, and formation of a clot; by internal medication to secure contraction of the blood-vessels in the diseased area, which are more susceptible than those elsewhere to the influence of anti-hæmorrhagic internal medication.

As local styptics, we may use hot water—as hot as can be tolerated. If this is not effective, alum in powder or solution; sulphate of copper; nitrate of silver; tannic acid; Monsel's solution, vinegar, lemon-juice, or the tampon. If there be erosion of the walls of the carotid artery the only hope—and a slender one it is—is by tying the common carotid artery.

Internal medication is often necessary. In a robust patient, if the remedy be not otherwise contraindicated we may use tincture of aconite-root, or tincture of veratrum viride, 2 to 3 drops, repeated as often as necessary in an hour or half hour. Among the others the best are gallic acid, given in powder in doses of 10 to 30 grains repeated as often as necessary; acetate of lead, 2 to 5 grains, in pill form—used but rarely; ergot also may be given with advantage.

If the hæmorrhage be of the oozing character, we may give turpentine, erigeron, or hamamelis in full doses.

Hæmorrhage from traumatism or from erosion by a neoplasm is essentially a surgical condition, and should receive such local surgical treatment as is recommended in standard treatises on aural surgery.

Syphilitic Otitis Media.

In the syphilitic, at some time in the period of general infection and subsequent localized cell-accumulation ("secondary stage") or in that of lymphatic obstruction ("tertiary stage"), there may develop, suddenly, as a rule, a variety of middle-ear disease, with or without involvement of the internal ear and perceptive apparatus, characterized by approximate immobility of the transmitting mechanism, and, obviously, by profound deafness and tinnitus.

If the affection be of quite recent origin, and if the inner ear and auditory nerve, on tuning-fork test, prove to be uninvolved, if the patient be non-scrofulous, of abstemious and regular habits, and if we can, without injuring him, give prolonged treatment with mercurials, we may expect some improvement at least therefrom, especially if we remove all extra-aural sources of reflex irritation to the affected organ. Mercury is valuable chiefly because, better than any other known

remedy, it prevents the later manifestations, the sequelæ, the tertiary phenomena of syphilis.

Where mercury, owing to a patient's idiosyncrasy, dyscrasia, or condition of general health, especially if scrofulous, tends to irritate or induce suppuration in the specific lesions, iodide of potassium may be used in doses of 5 to 10 grains three times a day in combination with a strong decoction of the fluid extract of sarsaparilla.[1] Smaller doses than those usually recommended have the endorsement and praise of experts equally eminent. Authorities differ not only as to the dose of mercury or iodide of potassium, but also as to the frequency of its administration.[2]

Biniodide of mercury has been recommended by Sexton, Theobald, and others. It may be given in small doses, with iodide of potassium, in the proportion of 1 grain of the former to 2 of the latter to make it freely soluble in water. (Theobald.)

An occasional inflation of the middle ear may hasten resolution and improve hearing.

For a complete study of the treatment of syphilis consult the article on Syphilis in Volume II. of this SYSTEM.

NEURALGIA OF THE MIDDLE EAR.

This variety of middle-ear disease can be diagnosticated by the positive exclusion only of every congestive, inflammatory, or other abnormal organic condition of the part.

Of the causes of otic neuralgia we may mention irritation or disease of the orbit, nares, pharynx, teeth, gums, or oral cavity, larynx, stomach, portal system, genital system, or emunctory organs; anæmia, lithæmia, nervous debility, fright, grief, prolonged exhaustion or anxiety; gouty, rheumatic, cancerous, or scrofulous diathesis; diabetes, nephritis; congestion of the kidneys, spinal cord, brain, or other capital organs; syphilis, influenza, malarial poisoning; traumatism; new growths; exposure to cold; the influence of crises of

[1] F. N. Otis, *Clinical Lectures on the Physiology, Pathology, and Treatment of Syphilis*, N. Y., 1881, p. 87.

[2] Compare Buck, "On the Use of Large Doses of Iodide of Potassium and Iodide of Sodium in the Treatment of Cases of Rapid Loss of Hearing," *Med. Record*, July 26, 1884; *Md. Journ. Med. and Surg.*, Aug. 2, 1884; *Med. News* (Phila.), July 26, 1884; ibid., "On Large Doses of Potassium or Sodium Iodide in Syphilitic Deafness," *Lond. Med. Rec., Cincinnati Lancet and Clinic*, Aug. 8, 1885; ibid., "Large Doses of Potassium or Sodium Iodide in Sudden Deafness of a Supposed Syphilitic Origin," *Trans. Amer. Otol. Soc.*, 1884, p. 243; *ibid.*, "Marked Improvement following Use of Iodide of Potassium in case of Sudden and Profound Deafness, due, apparently, to Inherited Syphilis," *Trans. Amer. Otol. Soc.*, 1887, p. 60; Sexton, "The Sudden Deafness of Syphilis, with Cases," *Amer. Journ. Med. Sciences*, July, 1879, p 57; Buck, "Syphilitic Affections of the Ear," *Amer. Journ. Otol.*, Jan., 1879.

development or decay, as of dentition, puberty, menopause, senility; mineral poisoning or drug habits.

The indications for treatment are to relieve the pain and to remove or counteract the cause, diathesis, or local or general disease upon which it is dependent.

There is scarcely any morbid condition in which the idiosyncrasy of a patient to the remedial influence of individual remedies is more pronounced than in this one. For this reason it may be necessary to try many remedies before one can be found to give certain temporary relief. Respecting treatment of the various causes by which the disease may be conditioned, the reader should consult *seriatim* the divisions of this work treating specially of them.

CHRONIC PURULENT DISEASE OF THE MIDDLE EAR.

By SAMUEL SEXTON, M. D.

For the general practitioner, under whose treatment many cases of ear disease are placed, especially those of children, a wide field for sound judgment is offered. For some of them a merely expectant course is indicated, with attention to general health. It is most important, however, that he should quickly recognize conditions which point to an unfavorable prognosis. Those who have ever had occasion to observe the grave complications arising in the course of chronic purulent middle-ear disease can testify to the danger of neglecting even mild cases.

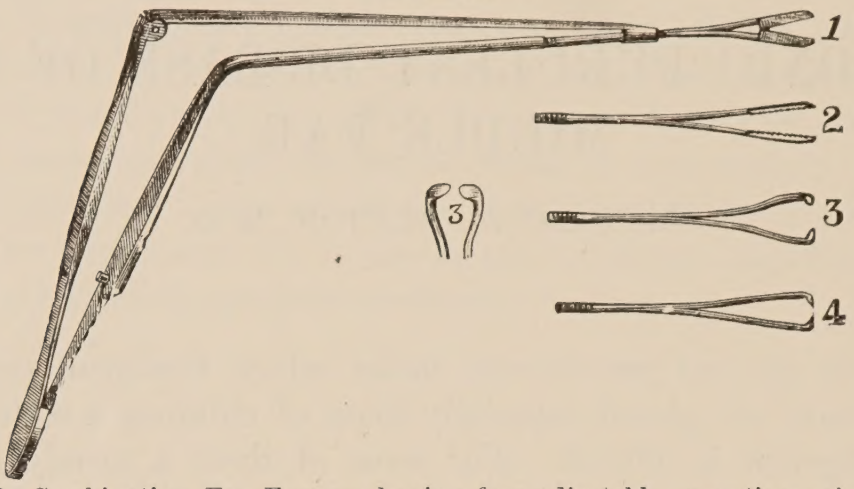
Many cases are mild from the beginning, and should be let alone. The use of astringents and local cauterization is of little or no use, and should generally be excluded as meddlesome. Indeed, such temporizing treatment may be pursued *ad finitum* without doing any good; for the most part it interferes with the natural tendency to a recovery or exaggerates the local conditions in the ear.

Too frequent use of the syringe is to be avoided, since its excessive employment injures the ear and humidity favors the growth of granulation tissue. All syringing and mopping out of the ear should be gently done.

In all mild cases, where the disease is for the most part confined to the atrium of the tympanum, the management should include attention to hygienic measures, the presence of head catarrh, diseased teeth, etc. Where the natural tendency to recovery is strong, there remains generally but slight damage to the transmitting mechanism, and the function of hearing is correspondingly injured but little if any. In these cases the mucous tract of the middle ear is the source of the muco-purulent discharge, and drainage is seldom impeded. A cure may be confidently expected from attention to cleanliness alone, the perforation giving exit to the discharge, in the more recent cases healing quickly. It is notable in the more chronic cases of otorrhœa that closure of perforations in the drumhead is often followed by impairment of hearing. In cases where irremediable damage has been done to the

sound-transmitting apparatus we shall find larger or smaller defects in the drumhead, the drum containing more or less granulation tissue and polypi, which sometimes entirely fill the cavity and also the external

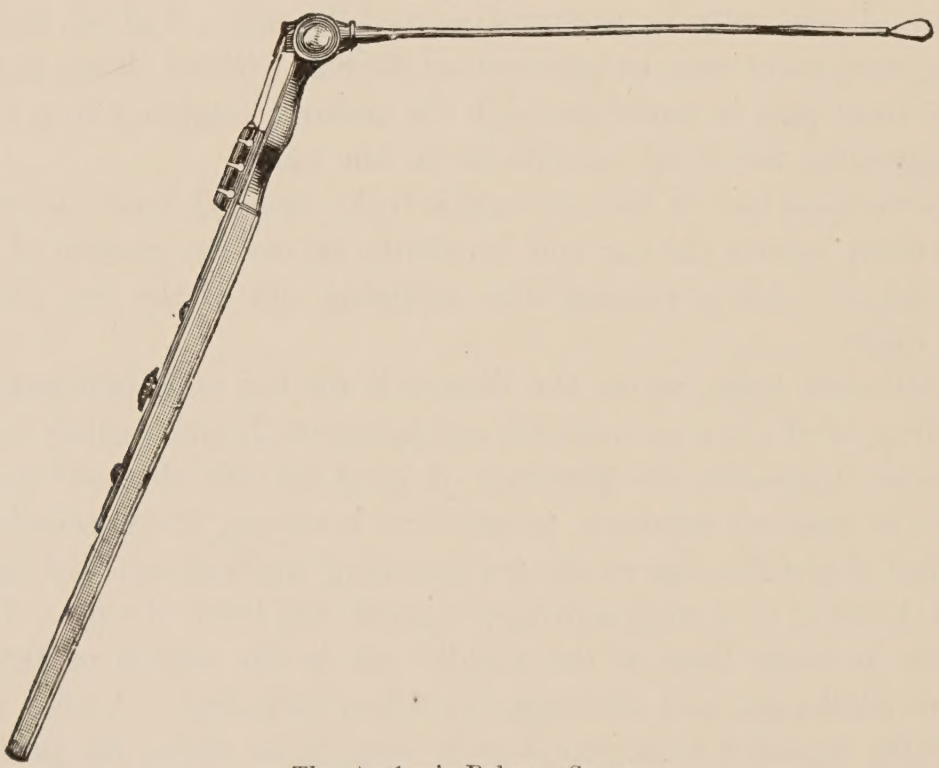
FIG. 159.



The Author's Combination Ear Forceps, having four adjustable operating points, namely—1, scissors, for clipping off redundant tissue from the walls of the canal; 2, serrated dressing forceps; 3, cutting forceps, for biting off granulations, etc.; 4, foreign-body forceps.

auditory canal. These should always be promptly removed with cutting forceps, the cutting curette, or the snare where the growth is of sufficient size to be engaged in the wire loop of this latter instrument. These morbid products cannot be easily removed from the attic by

FIG. 160.



The Author's Polypus-Snare.

instruments, but in such cases the better treatment consists in excision of the remains of the drumhead and the hammer and incus if present. Temporary relief may, however, be obtained by drying the parts after

removing granulation tissue, inspissated pus, etc., and applying by insufflation a dressing of salicylic acid, or a 45 per cent. solution of peroxide of hydrogen carried in on cotton wool. Under any such treatment, however, a more or less rapid reproduction of this morbid product is sure to take place; the writer, indeed, has scarcely ever seen an exception to this rule.

Since the removal of large masses of diseased tissue is generally very painful without an anæsthetic, requiring several tedious sittings, it is best to complete the operation at once under narcosis.

It is needless to say that the more completely the tympanum is cleared out the better, especially the point of attachment of the pedicle of polypoid growths. This is often difficult on account of profuse bleeding. Care should therefore be exercised in removing polypi to avoid unduly lacerating the part, especially with the fibroid variety of these growths, which are very difficult to detach or cut through with a wire loop, and often have to be brought away by evulsion. Mucous polypi are amputated much more easily. The attachment of the pedicle or base of both varieties should be sought after bleeding is checked, and detached with the curette.

Hæmorrhage is best controlled by syringing with hot water. The subsequent local treatment requires for its success that the parts should be kept as dry as possible, employing for that purpose tampons of absorbent cotton-wool wound upon the end of a stiff carrier. Above all, good drainage should always be maintained.

Boric or salicylic acid may be sparingly insufflated daily or as required, but its free use should be avoided. The instillation of a few drops of pure alcohol once or twice daily will often act as a check upon the growths: it is applied by means of a pipette or dropper while the patient rests the opposite side of the head upon a table or other object.

It is of the greatest importance to establish a rigid dietary for these patients, decidedly limiting both food and drink for a considerable period of time.

More importance, by far, is to be attached to personal hygiene than to any local treatment following the operation.

In most cases the ear after irreparable destruction of its sound-transmitting mechanism is at best a most defective organ and liable to constant recurrent invasions of purulency, as from taking cold, and had best be treated by entire removal of the diseased structures. This ensures drainage and generally improves hearing.

Purulency of the *tympanic attic* demands more than the passing allusion it has heretofore received at the hands of aural surgeons. Indeed, it has scarcely received any until of late. Attic cases are characterized, in the chronic state, by their persistency. The atrium

may be, and quite often is, quite free from any morbid action, whilst purulent matter is continually forming in the attic, or even in the mastoid, antrum, and neighboring cellules, and slowly escaping by a sinus leading outwardly through the membrana flaccida, usually just behind the malleus. An exploration into the pathological cavity beyond through this sinus generally reveals a very low form of inflammatory action, the cavity often containing, besides inspissated pus, cholesteatomatous masses and granulation tissue. Owing to the smallness of the sinus by means of which the attic is reached, and the presence of the diseased ossicles and numerous fibrous bands and the like, it is impossible to clean out this cavity and restore it to a healthy condition by treatment, although the worst symptoms may be checked for a time. In by far the greater number of these attic affections and the more severe forms of disease of the atrium already described the disordered and deranged chain of ossicles due to ankylosis, adhesions, and cicatricial bands running in all directions interferes not alone with the entrance of sound to a great extent, but shuts off the parts from a proper application and benefit from local remedies. In such cases no time should be lost with temporizing methods: the surgical removal of such obstructing tissues is absolutely necessary to a cure. The drum, encumbered with what was once the transmitting apparatus, becomes useless from destructive inflammation, and is more or less a reservoir for the retention of foul, decomposing secretions.

That the health of the patient should not fail to suffer from such septic collections constantly present in the drum of the ear seems improbable. The removal of the diseased structures has, in the writer's own experience, been followed by beneficial results, not only locally, but to the general health as well.

Those cases of caries of the tympanic attic, already alluded to, with a sinus opening through the flaccid membrane, constitute the most protracted and incurable form of ear disease. The removal of the entire membrane, together with the malleus and incus, establishes free drainage and brings about a cure unless the patient's general condition is extremely unfavorable. In cases, furthermore, where adhesive bands and attachments fill up the tympanum, causing more or less interference with sound even when no suppurative action exists, the operation is indicated. The fact that in some of the cases just mentioned more or less of the membrana vibrans remains should not restrain us from undertaking the operation if great deafness exists, as the hearing is generally much improved thereby and the annoying "gatherings and breakings" are prevented. The disagreeable subjective phenomena so often observed accompanying chronic purulent middle-ear disease, as headaches, noises in the head and ears, vertigo, and nausea, are usually entirely relieved by removal of the diseased tissues closing up the tym-

panum. Such subjective symptoms alone, the writer considers, in some cases may be so distressing as to justify this operation even should the hearing power be fairly satisfactory.

The operative removal of the carious and necrotic ossicles with the object of clearing the drum-cavity of obstructions to sound, establishing free drainage from the attic, and for the relief of a long-standing discharge, is not so recent as to be entirely unknown now-a-days to the majority of the medical profession. It is some thirteen years since H. Schwartze undertook this procedure for the first time, to be followed shortly by J. Kessel in 1879. Since that time the advocates of this method have steadily increased in numbers, particularly of late years—a gratifying fact, undoubtedly due to the excellent results obtained by the operation. Besides the many cases reported by Schwartze and Kessel, numerous others have been placed on record by the writer,[1] Kretschmann, Stacke, C. H. Burnett, Wetzel, Colles, Ludewig, Urbantschitsch, and others.

The writer's first observations were made a number of years since in cases where the transmitting mechanism had long been entirely destroyed by suppurative action, the drum-cavity being lined with a dry polished membrane. These led him, before being cognizant of the work done in Germany, to the belief that removal of obstructing and useless remnants of the transmitting apparatus would greatly benefit the hearing power and the discharge in cases where they were in a hopelessly diseased condition.

An operation should not be undertaken, especially in children, unless the discharge from the ear has been checked or very much diminished by abstemiousness in diet.

Method of Operating.—The writer uses an electric head-lantern for the purpose of illumination, the lamp being of six to ten candle-power, and attached to the head-band like the ordinary head-mirror. The operation is done under narcosis to ensure complete immobility of the head. With a small trowel-shaped or straight blunt-pointed knife the drumhead or its remnants are cut away around the periphery, all the attachments of the malleus, including the tensor tympani, being divided. In those cases where the incudo-stapedal articulation is intact this should also be divided. This may be accomplished with small angular-bladed knives made for this purpose, one for the right ear and one for the left. The malleus is then seized with the author's foreign-body forceps (see Fig. 159) and brought away. Some surgeons use the wire loop of the polypus snare in removing the malleus, and Lucae has a very good instrument of his own devising for this purpose. The incus, if present and in view, should be seized and extracted with

[1] *The Ear and its Diseases, etc.*, New York, 1888, chapter xvi. p. 358; also, *Deafness and Discharge from the Ear, etc.*, New York, 1891.

light dressing forceps. In many cases the incus is not in sight, and must be brought down into view by means of some instrument. For this purpose an ordinary malleable silver probe, bent at its point to a right angle, has proved itself very useful in the hands of the writer. All attachments, adhesions, and cicatricial bands existing in the drum should be thoroughly broken up.

In children, sometimes, large masses of steatomatous matter and inspissated pus are found lodged in the antrum, and cannot be so readily removed through the tympanum as by means of an opening from the outside directly into the mastoid antrum.

Hæmorrhage is never great, and can be easily controlled by syringing with hot water and the use of cotton-wool pledgets. Pain rarely follows, and if it does may be quickly allayed by instilling a few drops of a 4 per cent. solution of cocaine. After the operation the writer wipes or syringes the ear gently, and after thoroughly drying the parts introduces into the outer end of the canal a plug of cotton-wool impregnated with iodoform.

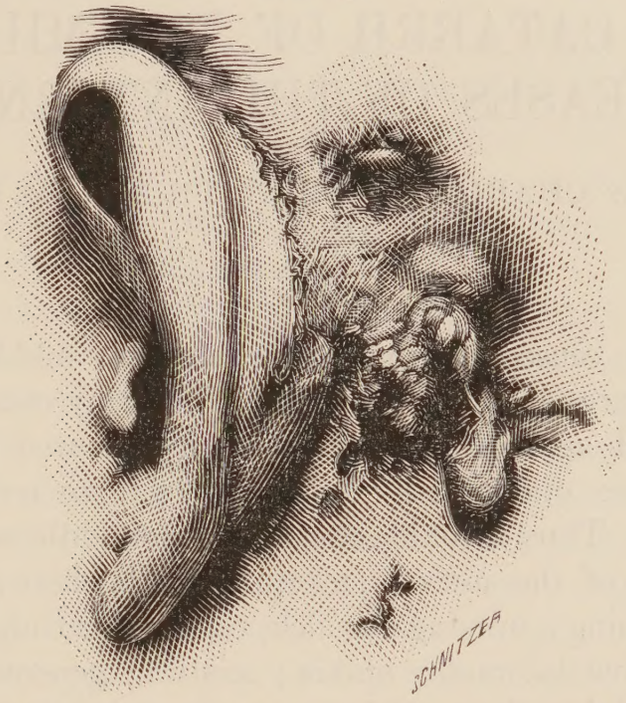
The operation is one without danger, no case of fatal result having been reported. In a few instances temporary paresis of the facial muscles has followed. It seems probable that this condition was largely due to irritation or injury of the nerve, whose canal had been previously affected or exposed by caries.

In the course of a few weeks or months after the operation the tympanum becomes dry, its walls being enveloped by a non-secreting, glistening, whitish, cicatricial membrane. Of course, where the bony walls of the drum and neighboring cavities have long been carious it cannot be expected that the otorrhœa will entirely cease at once. In some cases slight desquamative action of the parts may require the occasional removal of epithelial scales and the like. (For further details of the operation the reader is referred to the reports of the authors referred to and the writer's own works.)

In grave and complicated cases it will generally be found that an exacerbation of symptoms has taken place where the carious process has already involved the mastoid cellules. The secretions force their way out through the cortex of this process or through the posterior wall of the external auditory canal, drainage through the tympanum being obstructed. This state of things gives rise to very urgent symptoms in some cases, and if possible we should use the knife freely where a pointing indicates the position of the confined secretions. At such a place within the external auditory canal the integument will often be seen to bulge, partially closing the canal and having a purplish appearance. It is not unusual for a swelling of this kind to be mistaken for a polypus, and attempts made to remove the growth. The author has seen many such instances where bungling and offi-

cious surgical meddling has resulted in great local harm and serious demoralization to the patient. Sequestra presenting at such a point can be easily brought away by gentle handling with the foreign-body for-

FIG. 161.



Sinuses leading through Mastoid Cortex from antrum and tympanum, in a child. (From a photograph.)

ceps, the walls of the canal being gently dilated if swollen. Granulation tissue should be cleared away if it interferes with drainage or prevents the surgeon obtaining a view of the fundus.

Where secretions from the middle ear and the mastoid seek an outlet through the mastoid cortex, free exit should be given them in that direction.

In operations about the tympanum and mastoid care must be exercised to avoid wounding the facial nerve. As far as paralysis of the facial nerve is concerned, this may confidently be expected to disappear in the course of three weeks to three months.

For the alleviation of the severe pain about the mastoid and the neck often present in such cases veratrine ointment has been found of value. It may be applied several times daily. The faradic current is thought to be of benefit in restoring the power of the facial muscles.

CHRONIC CATARRH OF THE MIDDLE EAR AND DISEASES OF THE INTERNAL EAR.

By CHARLES H. BURNETT, A. M., M. D.

The common cause of chronic catarrh of the middle ear is chronic catarrh of the nares and naso-pharynx. In many cases chronic aural catarrh is found associated with, rather than caused by, certain diseases. The latter undoubtedly induce or keep up trophic changes in the middle ear. Thus chronic catarrh of the middle ear is found with chronic catarrh of the mucous membrane elsewhere; with phthisis; sorrow and weeping; nursing the sick, especially at night, with loss of sleep; progressive locomotor ataxia; sciatica; general neuralgia, but especially neuralgia of the fifth nerve; insanity; and intemperance and venereal excesses. It may also be found following pregnancy, the menopause, uterine diseases, continued fevers, any of the eruptive fevers, mumps, great shock after fracture of limbs, sedentary life, rheumatism, gout, and syphilis. In syphilis, instead of referring the sudden deafness sometimes occurring in that disease to an affection of the auditory nerve, it is much more rational to suppose that "granuloma or circumscribed small, round-cell infiltration takes place within the tympanum, that the invasion is rapid, and that it prevents by fixation the conductive apparatus from its normal movements."[1]

Among other causes may be cited sleeping on the ground in camp; duck-shooting, which involves sitting or lying still for long periods in wet or damp garments; exposure to draughts of air while at work, as with carpenters; and nervous exhaustion of a catarrhal ear by continuous shock, as in the case of boiler-makers and telegraph-operators and in those who use the telephone extensively.[2] Women—domestics and women doing their own housework—are constantly exposed to great changes in temperature and checks to perspiration. Their labor takes them one moment to the hot kitchen, and the next to a cold court or roof to hang out wet clothes, or from cooking in the house to scrubbing in the open air or cold room. To these facts may be added that such women are usually found in wet or very damp

[1] Dr. Samuel Sexton, *American Journal of Otology*, vol. ii. p. 301.

[2] Dr. C. J. Blake, *Proceedings Amer. Otol. Society*, 1888.

skirts, and when they rest for a moment it is usually without a covering for the head—at the front door or open window in a draught. In some families there is an hereditary tendency to catarrhal deafness. The intermarriage of members of such families tends to produce early deafness and deaf-dumbness.

Chronic catarrh of the middle ear is, as already stated, due to chronic hypertrophic catarrh of the naso-pharynx. The latter is usually the result of oft-repeated and neglected colds in the head, or naso-pharyngeal catarrh. As the hypertrophic condition in the naso-pharynx passes into the sclerotic or atrophic stage, the middle ear assumes a more or less similar condition.

The simplest form of catarrh of the middle ear is found in a case of acute or subacute coryza. In such an instance the congestion and swelling in the mucous membrane of the nares and naso-pharynx have induced impeded nasal respiration and a partial closure in the Eustachian tube, with defective aëration of the tympanic cavity.

The symptoms of this state are slight tinnitus aurium, an altered quality in hearing, some autophony, and at times a slight "light-headedness" or swimming in the head. Such symptoms usually subside either without treatment of any kind or under a mild, proper hygiene and treatment of the nares, naso-pharynx, and middle ears. If, however, the patient is in impaired health from any cause, or is exposed to all kinds of weather in his daily labor, the conditions in the nares, naso-pharynx, and ear may grow worse and become chronic.

Any case has become chronic when, after the acute symptoms of the cold in the head have passed off, the tinnitus and deafness are found to be fixed and gradually growing worse. In such cases the aurist is consulted usually anywhere from six weeks to six months after the symptoms have become chronic and annoying.

An examination of such a patient reveals an hypertrophic condition of the nares and naso-pharynx, the latter involving the faucial mouth of the Eustachian tube. The nasal respiration is impeded, and there is a tendency toward mouth-breathing, especially in the young. The fauces are in a condition of folliculitis, the tonsils and half arches of the palate sharing in the congestion and swelling. The membrana tympani in one or both ears, according to the extent of the affection, is somewhat retracted, and it may have lost its lustre. If not too thick, sometimes behind the membrana may be seen bubbles of air in a pale, amber-colored liquid. This latter is due to extravasations from the vessels of the wall of the drum-cavity, from which the air is shut off, and, the pressure on the vessels being reduced, extravasation follows. This condition is usually reached without much if any pain. The ear seems to slip at once into a condition of chronic hypertrophic catarrh of the secretory form. At this period of the disease much can be done

for the naso-pharynx and ear. If aid is not promptly given, a sclerotic stage is reached, when more labor is required.

Sprays.—The nares and naso-pharynx should at once be sprayed with the following solution:

℞. Sodii boratis,
Sodii bicarbonatis, āā. gr. viij;
Acidi carbolici, gr. iv;
Glycerini, fʒij;
Aquæ, q. s. ft. fʒiv.—M.

Or,

℞. Zinci sulpho-carbolatis, gr. v;
Listerinæ (Lambert's), fʒij;
Aquæ destill., fʒvj.

Or,

℞. Zinci iodidi, gr. v
Listerinæ (Lambert's), fʒij;
Aquæ destill., fʒvj.

These should be followed, especially in cold weather, by a spray of—

℞. Eucalyptol., ♏ij;
Glycolinæ, fʒj.—M.

Gargles.—The fauces should be treated either by solutions conveyed on a cotton-applicator by the surgeon or by means of gargles at home. In some cases both forms of treatment will be required in the more acute stages. If the fauces are in an atonic state, an application of tincture of perchloride of iron, 1 part to 2 or 3 of water, may be made to them once or twice a week.

Usually, however, the treatment of the nares and naso-pharynx will be sufficient to restore the fauces to a normal condition. It is my custom to order a gargle in cases of chronic catarrh of the middle ear, partly for the gymnastic effect on the velum, and thence on the tensor tympani and middle ear. If the chronic catarrh is still in the secretory stage, the patient is given a mild astringent gargle, as follows:[1]

℞. Rheos glabri, ʒj;
Glycerini, fʒj;
Alcoholis, fʒj, fʒj, ♏xxxvi;
Potass. chloratis, ʒij;
Aquæ, q. s. ft. ʒvij.—M.

About a half fluidounce of this should be used at a time as a gargle, night and morning.

[1] As prepared by H. C. Blair's Sons, Philada.

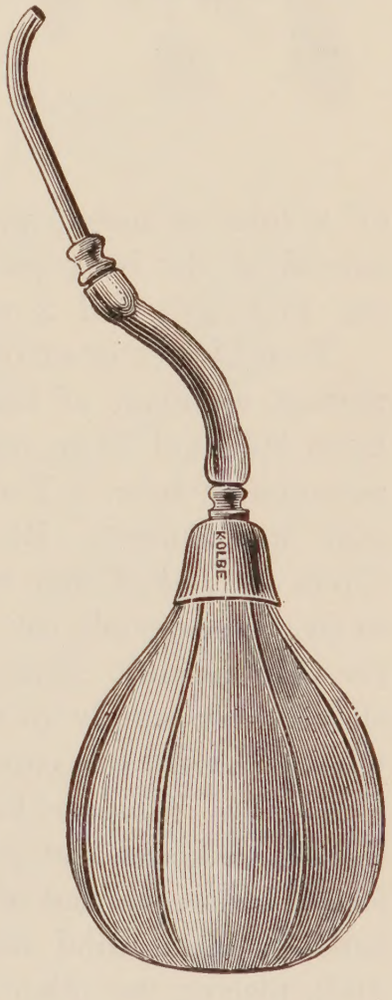
If the secretory stage has been succeeded by a dry or sclerotic one, the patient is then given the following gargle, to be used in the same way as the foregoing:

℞. Listerinæ (Lambert's), f℥j–f℥ij;
Aquæ, q. s. ft. f℥vj,

and the naso-pharynx receives the treatment adapted to a sclerotic stage described farther on.

Inflation of the Tympana.—After the nares and naso-pharynx are sprayed the tympana should be inflated with air. This may be done by Valsalva's or Politzer's method or by means of the Eustachian catheter and the hand air-bag. The first is an auto-inflation, consisting in the distension of the cheeks and holding the nose while air is forced up into the naso-pharynx and middle ear by strong expiration on the part of the patient. This method, being an active one on the part of the patient, is attended with congestion of the head and ear, and must therefore be used with caution.

Fig. 162.

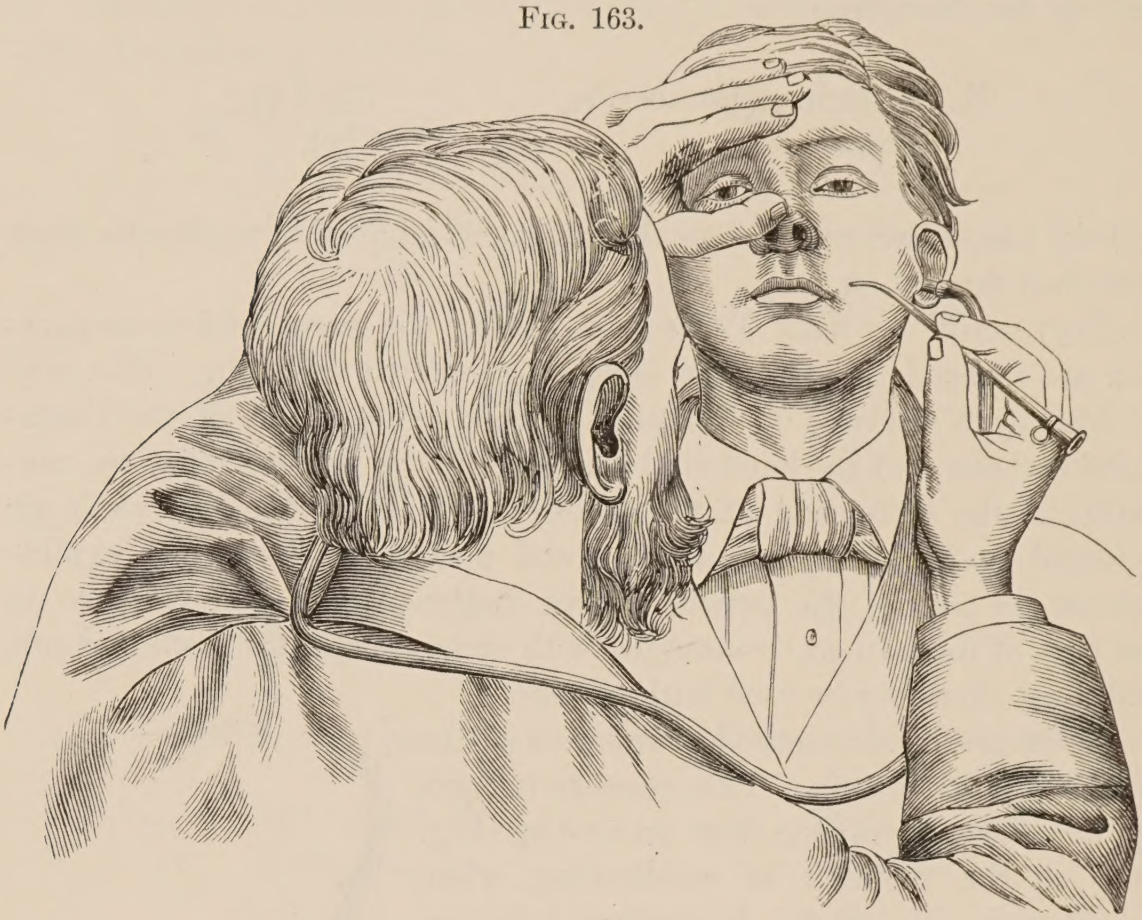


A far preferable method of inflation of the tympana is Politzer's. This consists in forcing air into the tympana from an air-bag (Fig. 162) at the moment of swallowing, when the faucial ends of the Eustachian tube are opened. The nose-piece attached to the inflation-bag being inserted into one nostril, the other nostril is closed by pressure with the finger of the surgeon. Then the ala of the nostril in which the nose-piece lies is gently compressed in front of the nose-piece, not down upon it. Then the patient, having previously had some water given him, is told to swallow with his lips closed. This act lifts the velum, shuts off the naso-pharynx from the lower pharynx, and opens the Eustachian tubes. If at such a moment air is thrown into the naso-pharynx by squeezing the air-bag, inflation of the tympana takes place. Instead of swallowing water, distension of the cheeks with air will accomplish the same object (E. E. Holt). Crying on the part of children, by lifting the velum, will aid greatly in the inflation of the tympana by Politzer's air-bag.

Eustachian Catheter.—In some cases Politzer's mode of inflation fails to accomplish its purpose, or it may be desirable to confine

the inflation of the naso-pharynx to one ear. We must then resort to the use of the Eustachian catheter. The Eustachian catheter consists

FIG. 163.



of a tube of metal, preferably of virgin silver, or of hard rubber, curved at the beak (as seen in the surgeon's hand in Fig. 163), 13 cm. in length and 2 mm. in diameter.

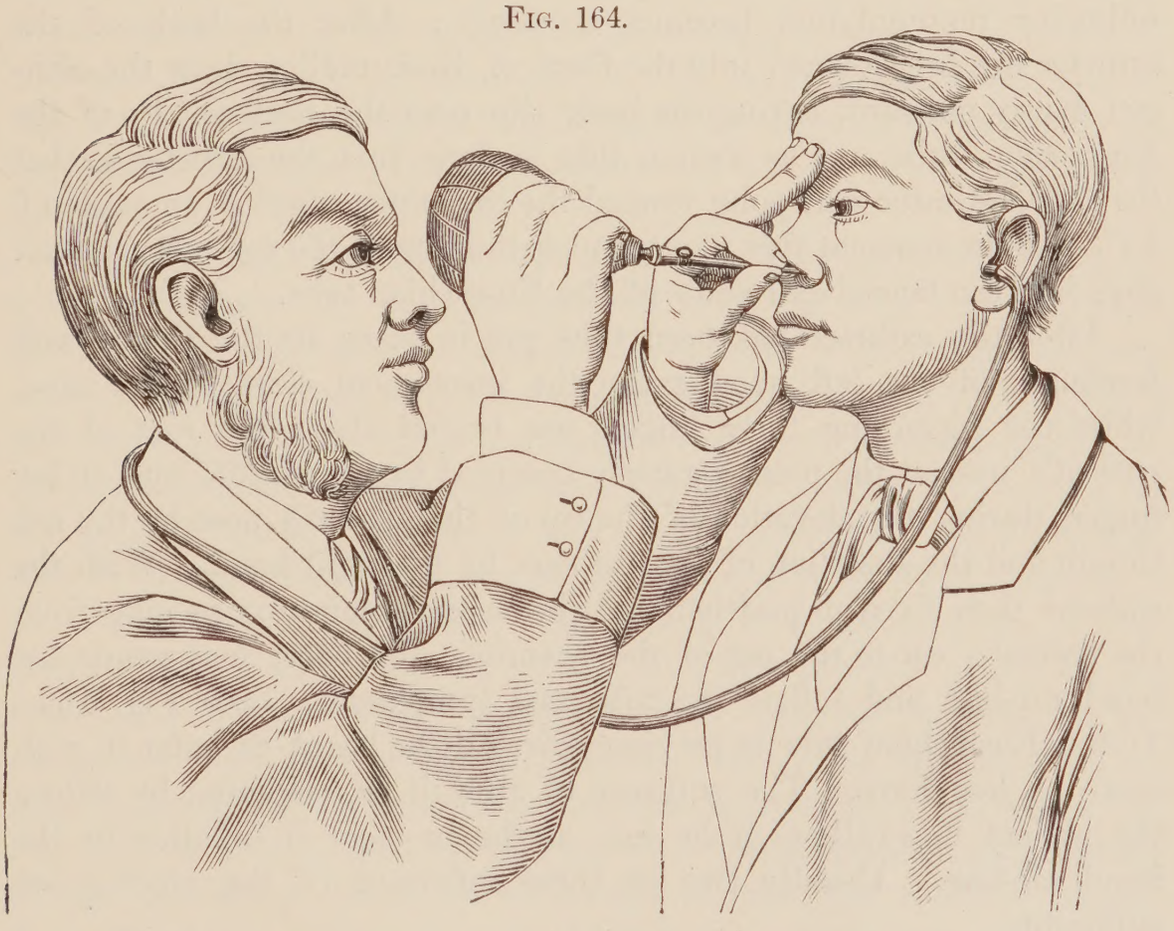
THE AUSCULTATION-TUBE.—This instrument is the highly important adjuvant of the Eustachian catheter: in fact, so far as the latter is of aid in an objective examination it owes that power to the auscultation-tube. The latter consists of a yard of rubber tubing 8 mm. in diameter. Black tubing is preferable, being most durable. Upon one end of this tube there should be a white bone end-piece to fit in the surgeon's ear; at the other end should be a black end-piece for the patient's meatus. In using the auscultation-tube one end should rest snugly in the meatus of the ear catheterized, while the other end must rest equally well, though not too tightly, in the examiner's ear. Suppose, for example, that the patient's left ear is to be catheterized, and that the auscultation-tube is also to be used. Let the surgeon place his end of the auscultation-tube in his left ear, bring the tube loosely behind his neck and over his right shoulder (see Fig. 164), placing the other end of the tube in the patient's left ear. If the auscultation-tube be thus supported, it is less in the surgeon's way and less likely to fall by its own weight out of his or the patient's ear.

THE AIR-BAG OR HAND-BALLOON.—The general shape and appearance of the hand-bag is seen in Fig. 162. Instead of the nose-piece, when the bag is used in connection with the Eustachian catheter there must be fitted to it a short "mount" for insertion into the proximal end of the catheter (Fig. 164). The use of such a bag of course is to force air through the catheter into the Eustachian tube. During expulsion of air from the bag great care should be taken not to force the axis of the bag out of line with that of the catheter, for if this should occur either by an upward or downward movement of the hand or wrist, the catheter will either break or bend and the patient will be hurt.

Catheterization of the Eustachian Tube.—Provided with a catheter, an auscultation-tube, and a hand-bag, the surgeon may endeavor to place the beak of the Eustachian catheter in the faucial end of the Eustachian tube by the way of the nose, so as to enable him to force air into the tube; and if that be patulous the air will pass into the tympanic cavity.

In catheterizing the Eustachian tube let the patient sit with his hips well back in the chair and his spinal column and head erect. The

FIG. 164.



latter may be placed against the wall or the back of the chair if high enough. Then, with the auscultation-tube adjusted as described, the surgeon should place the fore and middle fingers of his left hand on

the patient's forehead a little above the root of the nose, and with his thumb lift up the tip of the patient's nose and hold it up until the catheter is well inserted. With the tip of the patient's nose held as just described, let the surgeon grasp the catheter, as he would a pen-holder, between the thumb and forefinger of the right hand, holding his hand down about as low as the patient's chin, toward which the palm of the catheter-hand should be turned. Now insert the beak of the catheter into the nostril corresponding to the ear to be catheterized, and with a compound upward and forward motion carry the instrument along the floor of the nose until the beak reaches the naso-pharynx and at last touches the posterior pharyngeal wall.

The ring at the proximal end of the catheter, which the surgeon must keep always in sight, should point directly downward upon the arrival of the beak of the catheter in the naso-pharynx. With the catheter's distal end at the posterior pharyngeal wall the beak may be turned outward toward the ear to be catheterized. By this movement the beak will slip into the fossa of Rosenmüller. A common mistake at this point is to suppose that the beak now rests in the mouth of the Eustachian tube, and unsuccessful attempts at inflation may be made. In order to place the beak in the mouth of the Eustachian tube the following manipulation becomes necessary: After the beak of the catheter has been turned into the fossa of Rosenmüller, draw the catheter gently outward, letting the beak slip over the posterior lip of the Eustachian tube, and as soon as this is done turn the catheter so that the ring-indicator will point toward the ear catheterized at an angle of 45°. At the moment this movement is made with the catheter its beak slips into the faucial extremity of the Eustachian tube.

After the catheter has been thus put in place, let the thumb and forefinger of the left hand grasp the instrument close to the nose, while the remaining three fingers are braced above the root of the patient's nose at the point formerly occupied by the middle and index fingers during the elevation of the tip of the patient's nose by the left thumb and the insertion of the catheter by the right hand. With the catheter thus fixed in position, and the auscultation-tube passing from the patient's ear to the ear of the examiner, the latter may grasp the hand air-bag and inflate the tube and tympanum. (See Fig. 164.) If the Eustachian tube is pervious, air will be heard to enter it with more or less force. The entrance of air will be facilitated by telling the patient to swallow, if he can, at the moment of inflation by the hand air-bag. Usually two or three inflations of the air-bag are sufficient.

In using the Eustachian catheter for inflation the only danger is from emphysema about the fauces and epiglottis. But this can never occur unless the mucous membrane has been lacerated by the rough

insertion of the catheter, and this followed by very strong inflations. Serious emphysema of the pharynx and the parts about the glottis induces a condition similar to œdema of the glottis.

The treatment of emphysema of these parts should be by scarification of the mucous membrane, in order to let the air escape from the cellular tissue beneath.

Effects of Inflation upon the Drum-cavity and Membrana Tympani.—During Valsalva's inflation the surgeon may inspect the drumhead and the effects produced on it by the movements of the contents of the tympanic cavity. The membrana can also be inspected during Politzer's inflation if the surgeon stand beside the patient and illuminate with the forehead mirror the previously well-placed speculum. More or less bulging of the drumhead will be caused by inflation of the drum-cavity. If there are no adhesions between the membrana and the inner wall of the tympanic cavity, and if there is no ankylosis between the malleus and incus, nor any shortening of the tendon of the tensor tympani muscle, inflation produces a decided outward bulging of the membrana tympani. If there are depressed cicatrices in the membrana these will bulge outward beyond the plane of the membrane. If these are adherent while the rest of the membrana is free, they will become more depressed as the membrana is forced outward. If there is movable fluid in the drum-cavity, it will be forced outward against the drumhead, and bubbles may be seen through the membrana: an inspissated secretion in the drum-cavity will be seen to have shifted its position.

In some cases the bladder-like or blister-like protrusions of flaccid cicatrices induced by inflation are filled with air only, while in other cases they are filled with an amber-colored fluid. All of these appearances in the drumhead may also be brought out by suction with Siegele's pneumatic speculum. This instrument consists of an aural speculum, hermetically glazed at the outer end by a small pane set at an angle of 40° with the plane of the inner wall of the speculum. On the longer side of the speculum there is a small opening, to which is attached a piece of rubber tubing a foot long, ending in a mouth-piece for the surgeon (Fig. 165). During suction with this tube the action of the membrana tympani under rarefaction and condensation may be inspected through the glass at the proximal end of the speculum. This may be a magnifying lens of low power if so desired. If mucus or any morbid fluid is seen behind the membrana tympani, paracentesis of the membrana should be performed at once, and the fluid forced from the drum-cavity either by Valsalva's or Politzer's inflation or by both methods. With the speculum well adjusted and the fundus of the auditory canal illuminated by light reflected from the forehead-mirror (Fig. 166), an incision should be made in the most

Fig. 165.

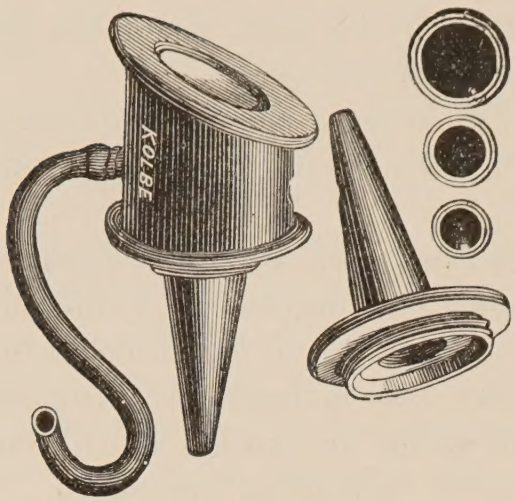
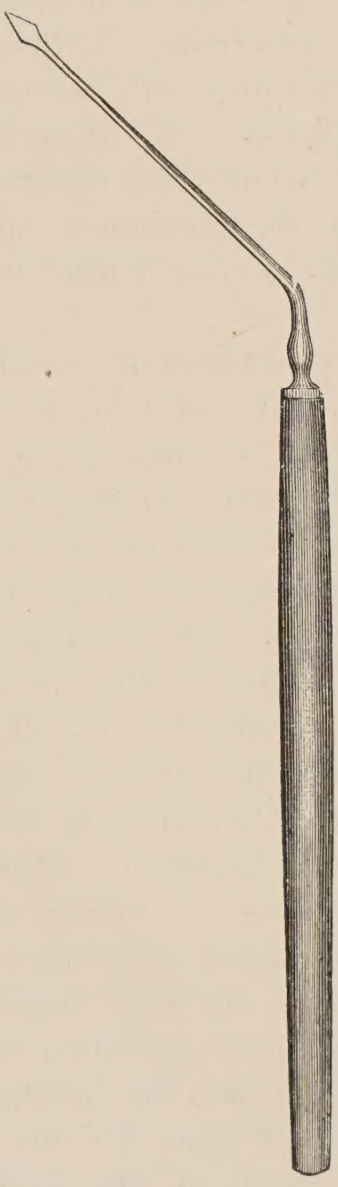


Fig. 166.

bulging portion of the membrana tympani, or, if it protrudes uniformly, then the paracentesis should be made in the lower posterior quadrant. The operation is not painful in chronic catarrh of the middle ear with accumulation of fluid behind the membrana tympani. The paracentesis knife is represented in Fig. 167. Paracentesis of the acutely-inflamed membrana tympani is very painful.

Fig. 167.

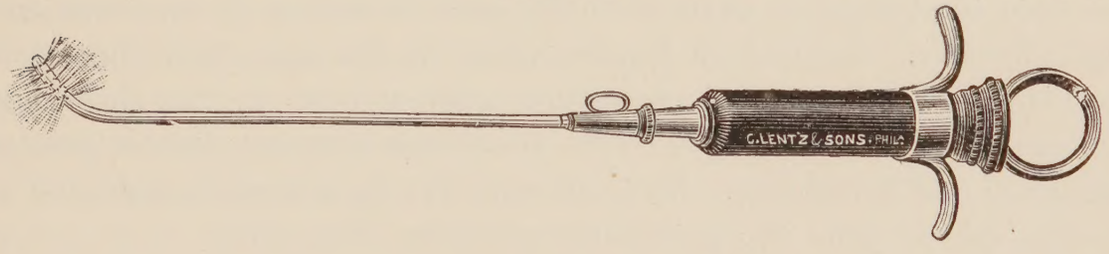


Re-accumulation of Sero-mucus in the Drum-cavity.—In some cases of chronic catarrh, in adults from thirty-five to sixty-five years old, there is a tendency to extravasation of serum into the drum-cavity. This generally comes without any special warning after a cold in the head or exposure of the ear to cold air or water. The hearing grows dull, and remains so after the other symptoms of a cold wear off. Inspection reveals a retracted membrana, amber color, and bubbles or the dark line of the surface of the fluid are seen behind it. Paracentesis of the membrana, as described, permits the serum to escape and the hearing becomes normal. Treatment of the naso-pharynx and inflations will not remove this fluid nor cause its absorption. Usually one or two paracenteses are sufficient to cure the disease, and there is no further accumulation. In other cases numerous paracenteses, at an interval of a month or two, are required—even as many as

thirty-eight incisions, as in a case reported by me[1] which was entirely cured. At present I have a case under treatment in which twenty-seven paracenteses have been required in two years. In both cases the Eustachian tube was and is pervious to Valsalvan and Politzer inflation. There were no symptoms of naso-pharyngeal catarrh to account for this reaccumulation of fluid in the tympanum. As in these two cases, and in some others with similar collection of tympanic extravasation, the subjects were men under considerable mental and physical strain in their business, I considered the repeated accumulation of serum in the drum-cavity as extravasation from congested tympanic walls, the latter condition being induced by general congestion of the head and ears.

THE SYRINGE-CATHETER.—A valuable adjuvant of the nasal spray is injection of various medicaments into the mouth of the Eustachian tube by means of the syringe-catheter. The latter consists in a catheter of the same dimensions and material as the one described on p. 1262. It is, however, stopped at the extreme end, and perforated with a number of small holes around the sides of the beak for an inch from the end. A metal syringe, which should work smoothly and accurately, with a mount at the end to fit into the proximal end of the catheter, must accompany it. This adaptation of the vesical syringe-

FIG. 168.



catheter was suggested by Dr. R. W. Seiss[2] of the Philadelphia Polyclinic. The syringe-catheter is introduced into the Eustachian tube like the Eustachian catheter. The fluid to be injected is previously warmed in a test-tube at a lamp-flame and drawn up into the syringe. After introduction and fixation of the syringe-catheter the fluid may be thrown into the Eustachian tube by means of the syringe. The fluid cannot go up the tube, as the end of the catheter is closed. It is not desirable that it should, as, if it should go up the tube as far as the tympanic cavity, the latter would be inflamed and the patient experience great pain and injury of his hearing. The injected fluid, however, escapes from the perforated sides of the beak, and the swollen walls of the Eustachian tube are washed clean of their mucus, and the catarrhal symptoms are thus treated and checked. Very useful solutions for such injections are Dobell's solution, solutions of boric acid (3 to 5 grains

[1] Burnett's *Treatise on the Ear*, pp. 409–415, H. C. Lea's Sons & Co., 1884.

[2] *Philada. Med. News*, Feb. 5, 1887.

to water 1 ounce), or solutions of listerine (1 ounce to water 5 ounces). A fluidrachm of these solutions may be injected thus into the Eustachian tube two or three times weekly.

Electric Cautery.—Notwithstanding the applications of spray to the nares and naso-pharynx, the vaso-motor paresis may continue. The lower turbinated bodies remain soft and hypertrophied. In such a case incisions with the electric knife, heated by a current from a dip-battery or a storage-battery, may be made at one, two, or three points in the swollen tissue. The cut should not extend to the periosteum. For fuller particulars as to the application of this form of cautery the reader is referred to that part of the book devoted especially to nasal diseases. Soft hypertrophies of the turbinated bodies are overcome by the application of a so-called chromic-acid "tack." After cauterization of the turbinated bodies the breathing-space is enlarged, the naso-pharynx is better aërated, and the Eustachian tubes and middle ear receive their proper ventilation. After such improvement in the nares, often the tinnitus is lessened and the hearing improves in one or both ears.

In many instances, however, relief is not applied for until the sclerotic stage in the nasal disease is reached and all the symptoms of tinnitus, hardness of hearing, and vertigo are marked. It will be fortunate for the patient if he seeks aid before the sclerosis should have involved the tympanic cavities to the same extent as in the nares and naso-pharynx. Instead of hypertrophies in the nose, now there will be found a paler mucous membrane with a more or less shrivelled appearance. The appearance of the membrana tympani denotes greater retraction and thickening. In some cases the membrana is restricted in its movements under the pneumatic speculum (Fig. 165).

The treatment in the nares and naso-pharynx should now be more stimulating. A spray of—

℞.	Acidi borici,	gr. xx;
	Listerinæ,	f℥ss;
	Aquæ rosæ,	
	Aquæ destill.,	āā. f℥ij,

may be thrown in with advantage, followed by a glycoline spray. The fauces may demand some gently stimulating application. After the sprays the naso-pharynx should be inflated by Politzer's method or by the catheter. (See p. 1261.) The above prescription may also be applied to the Eustachian tube by the syringe-catheter. For further treatment of hypertrophic catarrh in both the secretory and sclerotic stages the reader is referred to the part on nasal diseases in this work and other standard works on rhinology.

CONSTITUTIONAL REMEDIES.—These are often of great aid in chronic aural catarrh. The causative or attendant and aggravating maladies must be borne in mind, and the medication adapted to their nature. Much can be done in chronic aural catarrh by a prudent hygiene with special reference to avoidance of catarrh of the respiratory tract. In winter the patient must not dress *too warmly* nor sit in overheated apartments. In summer-time he must not dress too *lightly* nor indulge freely in sea- or river-bathing. Overheating in winter and too much cooling of the surface in summer induce catarrhs in the head and chest. These in turn excite aural catarrh, or render a case of chronic aural catarrh worse. Mouth-breathing must be avoided, especially in winter. This habit is largely due to carelessness in early life. The habit is permitted when it could be readily overcome by telling a child to breathe through its nose. An adult can overcome it easily by exercise of his will if no organic obstruction has formed in the nose. Even a child when told that mouth-breathing induces collapse of the nares, Eustachian tubes, and deafness will endeavor to stop this bad habit.

All excesses, especially in eating and in drinking alcoholic drinks, which tend to congestion of the head and ears, must be avoided in chronic hypertrophic aural catarrh.

Many subjects of chronic aural catarrh grow morbid over their dulness of hearing and avoid society. This leads to further depression of spirits, defective nutrition in the middle ears, and increased deafness. All such tendency to avoid companionship must be forbidden and prevented by the patient's family and friends.

Long-continued study or attention to business for many consecutive hours must be avoided. Daily exercise must be taken in the open air by riding, walking, or playing some athletic game. Great care must be observed to avoid chilling of the surface when fatigued and moist with perspiration. This is best accomplished by wearing *all-wool* under-clothing all the year round—very thin in summer of course, and not too thick in winter.

Hygiene and treatment, however, often fail to relieve the tinnitus, deafness, and vertigo. These remain stationary or grow worse in proportion to the ankylosis and retraction in the membrana tympani and ossicula. In such cases the only hope of relief lies in excision of the membrana tympani and the two larger ossicula. It is merely a loss of time to resort to section of the folds, insertion of eyelets, mobilization of the stapes, plugging the external auditory meatus to take off pressure from the membrana tympani, electrolysis of the Eustachian tube, and continued treatment of the fauces and naso-pharynx. If the latter is going to relieve the patient, it will do so in the course of three to six months at the longest. The best and quickest result of excision

of the membrana is obtainable in the earlier secretory stages of hypertrophic naso-aural catarrh in young subjects. In these the hearing shows the most improvement and the tinnitus and vertigo are most relievable. In more advanced and sclerotic cases the chances are against much improvement in hearing, especially if the process is of long duration in an adult. But even in these cases the tinnitus and vertigo are relieved, though the hearing be not much improved by the operation.

I have long maintained that *aural vertigo* is largely due to the mechanical pressure of the stapes inward upon the labyrinth-fluid.[1] This pressure may be exerted by fluids in the tympanic cavity or by the retraction of the ossicles consequent upon a vacuum in the drum-cavity and the collapse of the membrana tympani. When the Eustachian tube is closed by swelling or inspissated mucus for any length of time, the air in the drum-cavity is absorbed and a vacuum is formed with the above-named results. The labyrinth fluid is thus unduly compressed by the impacted stapes, the terminal filaments of the auditory nerve are irritated, and this irritation is communicated by the motor fibres in the auditory nerve to the cerebellum.

Tinnitus and Deafness in chronic aural catarrh are often produced in the same mechanical way as the vertigo, as we are forced to conclude from the relief afforded from all three of these symptoms by surgical removal of the mechanical retraction and impaction of the ossicula, with their consequent irritation exerted upon the middle ear, and thence upon the internal ear.

Being thoroughly convinced of this fact after twenty years of close observation of aural phenomena, I have within the last three years resorted to the operation of excision of the membrana tympani[2] and the two larger ossicula, with most encouraging results in those cases of chronic aural catarrh where all other rational means failed to relieve the deafness, tinnitus, and vertigo from which patients so earnestly desire relief. Since the treatment of chronic catarrh of the middle ear, with its attendant deafness, tinnitus aurium, and vertigo, forms about three-fourths of the aurist's work, and as the results of means hitherto employed are often unsatisfactory, any new form of treatment which promises help in this very intractable malady commands our attention as humanitarians, as physicians, and as aurists.

Excision of the Membrana Tympani and the Two Larger Ossicula in Chronic Hypertrophic Catarrh of the Middle Ear.—The following case shows the advantages of this operation in chronic hypertrophic catarrh of the middle ear in the secretory stage.

[1] A paper on "Aural Vertigo," *Phila. Med. Times*, June 3, 1882.

[2] Employed by Lucæ of Berlin (1881) and Schwartze of Halle (1873); revived and elaborated by Sexton of New York since 1886.

In all cases of chronic catarrh of the middle ear we have to contend with ankylosis, in whole or in part, of the conductors of sound lying in the middle ear, incurable in most cases excepting by the operation of excision as above named. The relief obtained in the case about to be narrated can be explained in no other way than that the removal of the ankylosed membrana, malleus, and incus permits the stapes to vibrate more freely in its oval window. If the stapes is also ankylosed, the relief of deafness is slight or is entirely wanting, as in a case of sclerosis of the middle ear reported farther on in this article, though even in such cases the tinnitus and aural vertigo may be entirely and permanently cured.

July 15, 1889, Mrs. X——, twenty years of age, stated that eighteen months previously she had camped out in Syria. She found it very damp and cold at night, and took a severe cold in her head. Since then she has had pulsating tinnitus and increasing hardness of hearing in her left ear, with fulness in the head and at times vertigo from the excessive tinnitus. Upon returning her family observed that her voice sounded as if she had a cold in her head. During the past year she underwent treatment of the fauces at the hands of an oculist, who also inflated the ears by Politzer's method, but without benefit; in fact, all the bad aural symptoms increased.

When first seen by the writer her condition was as follows: Left membrana tympani retracted and depressed, especially over the incus-stapes joint. Hearing in the left ear four feet for isolated words of ordinary conversational tone. There was a constant, pulsating tinnitus in the left ear, with some slight constant singing tinnitus in the right ear. The Eustachian tubes were pervious to inflations. The nares showed general, active, hypertrophic catarrh. The pharynx was in good condition.

TREATMENT.—Dobell's spray was used by the patient once daily at home. In the course of a fortnight the nares looked better and the tinnitus in the right ear became much less. The tinnitus in the left ear, however, was no better. The catarrhal symptoms grew worse by September, 1889, and from this time until March, 1890, treatment consisted in the use of Dobell's spray by the patient at home and in injections into the Eustachian tubes by means of the syringe-catheter once or twice a week by me. The hearing in the left ear, however, diminished to *six inches* for isolated words and the tinnitus was great and annoying. The hearing in the right ear remained very good and the tinnitus very slight.

By August, 1890, as the sprays to the nares and the injections into the Eustachian tubes did no good, and as the hypertrophies from vasomotor paresis remained undiminished and the nasal respiration was impeded, each lower turbinated mucous cushion was incised at three

points, one behind the other, at six different times by means of the galvano-cautery. This permanently reduced the hypertrophies, restored the nasal respiration, the catarrhal symptoms in the naso-pharynx becoming better, but the ear-symptoms remained unimproved.

In March, 1891, the hearing in the left ear was only six inches for isolated words and the pulsating tinnitus very great, with sudden accessions, which induced great vertigo. It was therefore decided to perform excision of the membrana tympani and the two larger ossicula in the left ear.

The Operation.—On March 5, 1891, the patient was etherized, and under illumination of the ear by means of the electric head-lamp an incision was made through the membrana tympani, comprising its upper posterior quadrant, and the incus exposed. I then passed a small oval blade, two mm. long, set at right angles to the shaft, behind the incus, severed the incus-stapes joint, drew the incus a little downward with the blade of the knife, and, seizing the incus with forceps, lifted it from the tympanic cavity. Then I excised the rest of the membrana about the periphery and withdrew the malleus and the membrana from the auditory canal. The ear was then dressed with a tampon of bichloride cotton[1] placed about halfway down the canal. The next day there was no reaction, but the hearing was now *four feet* for isolated words. The tinnitus was not diminished. The ear had lost its stopped-up feeling, and all sensation of pressure in it had gone.

On the third day after the operation, after exposure to cold wind, the ear began to bleed a little, and finally a glairy, transparent, mucous discharge set in, and continued for about six weeks, when the regeneration of the membrana tympani became complete. On April 29th the new imperforate membrana was plainly seen, somewhat congested. Hearing for isolated words was now *four feet.* The tinnitus was still considerable. On June 4th the new membrana was uncongested and bluish. Hearing for isolated words was *twelve feet.* Pulsating tinnitus and vertigo had ceased. There was some slight, constant tinnitus if the patient listened for it, but no sensation of fulness in her left ear. *The patient says she can hear conversation of a companion sitting on the left side without turning around, as she had to do before the operation.*

I would call attention first to the improved hearing (from six inches to four feet) immediately after the operation, and also to the disappearance of the sensation of pressure in the ear, so annoying before the operation. Doubtless, the latter sensation was due to the pressure from retraction of the membrana and ossicula.

Secondly, note the progressive improvement in hearing notwith-

[1] The writer now employs in such cases a tampon of iodoform-cotton, since a bichloride tampon may irritate the ear.

standing regeneration of the membrana tympani. The stapes, being now unimpeded by the retraction of the membrana and ankylosed malleus and incus, vibrates under sonorous waves, notwithstanding the intervention of a new membrana.

Thirdly, and with emphasis, I would call attention to the entire relief from pulsating tinnitus and attacks of dizziness. The relief of the vertigo is due to the removal of the mechanical pressure exercised by the in-drawn malleus and incus upon the stapes. The latter consequently, being freed from impaction in the oval window, no longer compromises the labyrinth-fluid and irritates the motor filaments of the auditory nerve. The tinnitus is diminished because the congestion in the middle ear, due to the irritation brought about by the above-named retraction and impaction in the oval window, is removed.

Excision of the Membrana and Malleus in Sclerosis of the Middle Ear.—The following case illustrates the beneficial effects of excision of the membrana tympani and malleus in the sclerotic form of chronic catarrh of the middle ear, characterized by deafness, tinnitus, and aural vertigo.

Miss D——, aged thirty-one, consulted me in November, 1881, for deafness in her left ear, in which ear she had had earache and suppuration in childhood. Gradually the hearing had failed in this ear until it interfered with her work as a trained nurse. Latterly there had been persistent, loud, high-pitched, and distracting tinnitus in the left ear, with a sensation of pressure and confusion in the head, but no marked attacks of vertigo. She felt depressed and could not do her work as well as usual. The hearing in the affected ear was six inches for isolated words of ordinary tone. The tuning-fork on the vertex was heard best in the affected ear.

The membrana tympani of the left ear was white, thick, and flattened, but without visible cicatrices. The pharynx and nares showed signs of hypertrophic catarrh in a sclerotic stage. The left tympanic cavity was inflatable by the various methods. Treatment of the nasopharynx relieved the catarrhal symptoms of those parts without affecting the deafness, tinnitus, and other head-symptoms, though continued for ten months.

The patient then removed to another city and was not seen by me for six years. In the autumn of 1887 she wrote to me stating that the tinnitus in her left ear had grown much worse, and she experienced severe attacks of vertigo at times from the noise and confusion in her head.

On May 16, 1888, the patient called to see me, and I found that her general health was good, notwithstanding which the aural symptoms had grown worse. An examination of the left ear showed that the membrana tympani was white, retracted, and adherent to the inner

wall of the drum-cavity, but movable under the pneumatic speculum excepting in the line of the malleus. The hearing remained six inches for isolated words. *The tinnitus was constant and distracting, there was a permanent sensation of pressure in the ear, and attacks of ear-vertigo had been increasing in frequency and intensity for a year. At times the latter were so severe as to oblige the patient to hold on to a lamp-post for support when a vertiginous attack occurred in the street.*

Being now convinced that the tinnitus, the sense of aural pressure, and the attacks of vertigo were due to an inward pressure exerted by the retracted membrana tympani and the chain of ossicles upon the labyrinth-fluid, and thence upon the nerves in the internal ear, I proposed excision of the retracted and adherent membrana and malleus as the only means of permanently relieving the abnormal labyrinthine pressure and the symptoms caused by it. It was hoped that such a removal of the membrana and adherent malleus would free the incus and stapes, and allow the latter to retire from its impacted position in the oval window, and thus take off its pressure upon the fluid in the vestibule. No great hope of relieving the deafness by the operation was held out to the patient in this case, owing to its long duration in a sclerotic ear. But the patient declared she would be entirely satisfied if the tinnitus and aural vertigo were relieved, regardless of the effect on the little hearing still left in the ear. Therefore on May 21, 1888, the patient was placed on a table, her head and shoulders slightly elevated, and etherized. The table was then brought in front of a window looking toward the south, and daylight reflected into the ear. It had been my intention to illuminate the ear by an electric lamp held on the operator's forehead and supplied by a small portable storage-battery, and the apparatus was at hand. But the daylight happening to suit in this case, the ear was illuminated by the ordinary forehead-mirror.

An incision was then made behind the short process of the malleus, and the tendon of the tensor tympani muscle severed by a curved knife passed through the initial incision. Then with a blunt-pointed knife the entire membrana was cut out around its periphery, and the malleus and membrana were removed together by forceps.

Inspection of the removed malleus revealed a thread-like strip of bone 3 mm. long, running from the lower end of the manubrium of the malleus inward to the promontory, which had evidently bound the malleus to the inner tympanic wall, and explained the adhesion which had been diagnosticated before the operation. There was no incus visible. The slight hæmorrhage was controlled, apparently by a 5 per cent. solution of cocaine muriate.

As soon as the patient recovered from the etherziation she stated that the tinnitus was very much less, and that the sensation of fulness and pressure in the ear had greatly diminished. She remained in bed

twenty-four hours by my direction; on the third day she went out walking. The tinnitus was now barely audible, and its note had become much lower in the scale. There was no sense of fulness in the ear, nor *was there any tendency to aural vertigo.* There was no inflammatory reaction nor any bleeding. The hearing was unaltered. A tampon of iodoform-cotton was worn lightly in the meatus. She remained under immediate observation one week, during which time she expressed herself as feeling the greatest relief in the ear. There was no discharge of any kind nor any sign of regeneration of the membrana tympani.

Under date of June 4, 1888, the patient wrote that though some tinnitus was still heard she felt much better. *There was no sensation of fulness in the ear nor any vertigo.*

Under date of June 12, 1888, she wrote that "a slight discharge had come from the ear, but that in all other respects the benefits of the operation had been maintained—that she felt no noise in her ear, sense of fulness, nor vertigo." This discharge soon ceased under a mild antiseptic treatment, and the regeneration of the membrana began.

Under date of July 13, 1888, the patient stated that the noise in the ear was now so slight that she had to listen for it in order to hear it, so that it had practically ceased. There had been no attack of vertigo, and she wrote that "the relieving of either of these distressing symptoms (tinnitus and vertigo) would be sufficient to make me glad to have had the operation performed."

On September 20, 1888, I examined the ear, and found that a new thin membrana had formed. There had been no return of tinnitus nor vertigo, and there has been none to the present time, over three years from the date of the operation. The hearing remained as before the operation, six inches for the voice. The right ear is entirely normal.

It is shown by these cases that—

(1) Tinnitus aurium and aural vertigo are often due to disease in the middle ear, and that it is an error to refer them hastily to disease in the internal ear.

(2) Tinnitus and vertigo are evidently caused by impaction of the stapes in the oval window and pressure on the labyrinth-fluid induced by retraction of the malleus.

(3) The removal of the latter in such cases liberates the stapes and relieves the tinnitus and vertigo caused by its inward pressure upon the vestibular fluid, and mediately upon the terminal nerve-filaments in the labyrinth.

(4) In chronic cases, like the second, the deafness continuing after the operation is probably due to atrophy of the auditory nerve-fibres in the labyrinth from the long-continued compression of the lymph contained in it.

(5) Excision is usually followed by regeneration of the membrana tympani. The latter has no retractive power, however, as it possesses no ossicular connection with the middle ear. Hence the new membrana is attended by no return of the tinnitus or vertigo, nor does it always interfere with the improved hearing, as shown in the first case. If the new membrana interferes with the improvement in hearing immediately following the operation, it may be broken down as often as it re-forms until its reparative power is thus overcome.

DISEASES OF THE INTERNAL EAR.

THE internal ear includes the labyrinth, composed of cochlea, vestibule, and semicircular canals, and the auditory nerve. Diseases of the internal ear are not very common, they are not easily diagnosed, and for the most part they are incurable. Nevertheless, as diseases of the middle ear are often mistaken for diseases of the internal ear, and as the latter are relievable in some instances if not entirely curable, it will be well to consider some of the best-known phenomena characteristic of diseases of the internal ear, and the best means of relieving them. It will be seen that some diseases of the internal ear originate from without, as in transmissions from the middle ear, while others originate from within, as in cerebro-spinal meningitis and from morbid growths within the cranium.

Nervous Deafness.—This is a vague term often applied to functional changes in the auditory nerve or some other part of the internal ear not easily definable. Most alterations in hearing classed as nervous deafness are reflex changes in the vascularity of the Eustachian tube and middle ear, induced by irritant causes like dyspepsia, malaria, hysteria, venereal excesses, etc.

Central deafness due to disease of the auditory nerve has been described by Bürkner.[1] In that case the reception of very bad news caused a man forty-seven years old, who possessed perfect hearing and vision, to become hard of hearing in four days, and entirely deaf in two months. In six months he became entirely blind. There were also vertigo and disturbed equilibrium. Tinnitus was marked at first, but gradually disappeared. The simultaneous occurrence of deafness and blindness, the failure of bone-conduction, the absence of all objective symptoms in the eyes and the ears, were considered as indicative of a central lesion. Syphilis was excluded as a cause.

Paralysis of the Sympathetic Nerve in the Neck is said to be characterized by sudden loss of sight and hearing, with violent pains in the

[1] *Archiv für Ohrenh.*, Bd. xxi. p. 177.

corresponding side of the head. Considerable narrowing of the pupil and dilatation of the vessels of the retina may be detected, but no abnormality can be seen in the ear. The diagnosis in such a case has been verified by the treatment, since all manifestations disappeared after four days' administration of ergot.[1]

Affections of hearing and speech from disease of the temporal, occipital, and lower parietal lobes of the brain have been ably described by many authorities. Ferrier maintains that the cortical seat of the function of hearing lies in the temporal lobe. Loss of voice and hearing, preceded for months by intense headache, has been observed as the result of colloid degeneration of the temporal lobes on both sides. The difficulty in speech was caused by the disease in the third frontal convolution. Hemiplegia, ataxia, aphasia, subparalytic conditions of the tongue, inability to distinguish words, with normal hearing, however, have been observed as due to pachymeningitis hæmorrhagica, by which the left temporal lobe, as well as the third frontal convolution, had been compressed and degeneration in them induced. The sensory aphasia, or inability to distinguish words, is attributed to disease of the temporal lobe.[2] The same observers demonstrated that the diagnostic difference between ataxic aphasia and deafness for words is that in ataxic aphasia both hearing and understanding of spoken words are present, while in sensory aphasia hearing is preserved, but an inability to understand words exists.[3]

Aphasia, paraphasia, and deafness for words have been shown to be due to softening of the lower *parietal* lobe, of the adjoining posterior portion of the first and second temporal gyri, of the posterior transverse temporal gyrus, and of the posterior gyrus of the island of Reil. A portion of the second occipital gyrus of the occipital lobe, a few millimetres in breadth, was similarly affected. Embolism of the parieto-sphenoidal branch of the left artery of the Sylvian fossa was found in such a case.[4]

Atrophy of the occipital lobe is found in some cases of profound deafness of long duration, with destruction of the trunks of the auditory nerves, as in some cases of deaf-muteness.[5]

Hallucinations of Hearing in the Insane.—Tinnitus aurium occurring in the insane would of course be misunderstood by the sufferer and give rise to hallucinations of hearing. Investigations of subjects affected with auditory hallucinations have been made by Fischer. In a case of pronounced melancholia, with vivid hallucinations of all

[1] Kispert, *Deutsche Zeitschrift f. Prak. Med.*, 1878, and *Archiv für Ohrenh.*, Bd. viii. p. 197.

[2] Kohler and Pick, *Archives of Otology*, vol. ix.

[3] *Zeitsch. für Heilkunde*, vol. i. H. 1.

[4] I. Fritsch, *Wiener med. Presse*, No. 15, 1880.

[5] Luis, *La France méd.*, No. 29, 1880.

the senses, it was found that no sensation was excited in the acoustic nerves by strong galvanic currents, and that the hallucinations ceased almost entirely during the continuance of the current. A regular galvanic treatment of the brain with eight or ten elements, the current being passed through the head from side to side and from back to front, carried out every day for two months, effected steady improvement and eventually complete cure. Upon the cessation of the subjective noises in the ear the hallucinations disappeared. In such cases Fischer claims that delicate disturbances in the nutrition of the central nervous system underlie the auditory affection.

Auditory hallucinations have also been observed in those in whom have been found after death hyperostosis and exostosis in the tympanum, with ankylosis of the head of the hammer, bony occlusion of the round window, and colloid degeneration of the auditory nerve in the petrous bone. Hallucinations of hearing may also be present in those affected with hæmorrhagic pachymeningitis, atrophy of the semicircular canals, and in cases in which the carotid artery has been found dilated at some points while indurated and narrowed at other in its passage through the temporal bone. In the latter instance it may be maintained that tinnitus aurium would certainly exist from impeded flow and morbid vibrations in these blood-vessels. Such tinnitus would be misunderstood by the insane and give rise to hallucinations of hearing.

Rachitic alterations and disturbed development, like chronic leptomeningitis and hydrocephalus internus, hyperostosis of the cranium, sclerosis of both mastoid portions, and osseous malformations in the middle and internal ear, have been found associated with cretinism.[1] Both auditory nerves were found diseased in the internal auditory canal.

Neuropathic Aural Vertigo.—The experiments of Flourens, which seemed to attribute to the semicircular canals the rôle of maintaining the equilibrium of the body, have been controverted by others to such an extent as to make it appear doubtful whether that part of the labyrinth is the seat of the lesion which determines the so-called vertigo of Ménière. The peculiar character of the vomiting, the fact that the latter symptom may occur suddenly without nausea after irritation of the membrana tympani, the intimate connections between the pneumogastric and the auditory nerve at their origin, render it more probable that the vertigo and cardiac symptoms are due to a reflex action on the pneumogastric, dependent upon a lesion in some portion of the auditory nerve. The term "Ménière's disease" serves very frequently to mask ignorance of the lesion which occasions a series of symptoms often analogous, but

[1] Moos and Steinbrügge, *Archives of Otology*, vol. xi.

which are under the influence of very different causes.[1] In fact, there is no such thing as Ménière's disease, any more than there is a Flourens' disease.

A neuropathic form of aural vertigo usually exists with tumors in or about the auditory nerve. The morbid growth may lie either in the central origin of the nerve, along its trunk, or in the terminal filaments within the labyrinth. The symptoms of an aural vertigo of neuropathic origin are as follows: In a subject over forty years old there may be suddenly developed violent tinnitus aurium in one or both ears. The hearing fails without objective changes in the conducting apparatus. In the course of a year the attacks of vertigo become frequent and of greater or less severity, especially on raising the head. There may be no inclination to fall in any particular direction. The tinnitus may be relieved by the constant electric current. In time ptosis and dilatation of the pupil on the side with the affected ear may be noted, with great pain in the corresponding parietal region. The patient may now require assistance in walking, and the gait becomes peculiar, high-stepping. Soon confinement to bed becomes necessary, and inability to move the head ensues. The muscles of the neck may become tender, but without contraction. Facial paralysis may set in on the side of the diseased ear a month before death; the sensorium may be clear most of the time, with periods of maniacal excitement and delusions. Deafness continues; the tinnitus may be less, but the parietal headache may be intense. Constipation and ischuria may be present. Speech becomes difficult, slow, and rattling, and death occurs with paralysis of the palate and pneumonic symptoms.

In such a case, described by O. Wolf, a post-mortem examination revealed in the tonsilla cerebelli of the right side a tumor the size of a large cherry, reddish in color and firm in consistence, vascular, with uneven surface, which pressed upon the origin of the acoustic nerve in the fourth ventricle, so as to produce paralysis of the left auditory nerve, basilar meningitis, and numerous foci of endarteritis in the basilar artery. The patient had had syphilis twenty years before. (See also symptoms in Sarcoma of Auditory Nerve, farther on in this article.)

Great changes in the *auditory nerve* and *labyrinth* are produced by *chronic otorrhœa* and *caries*. The purulent masses in these portions of the internal ear are found permeated with rod-like bacteria, and the conclusion is obvious that in such cases cerebral abscess is due to migration of the micro-organisms along the blood-vessels or connective tissue about them.[2]

[1] Sir Wm. B. Dalby, *Brit. Med. Journal*, and *Annales des Maladies de l'Oreille*, vol. xvii.

[2] McBride and Bruce, *Archives of Otology*, vol. ix. p. 365.

Permanent Alterations in Hearing produced by Quinine and Salicylic Acid.—The well-known aural symptoms following ordinary doses of quinine, like tinnitus aurium, altered hearing, and constriction in the head, vary in intensity and duration according to the dose or doses given. But there are well-known reasons why large doses of quinine produce sometimes permanent alteration in hearing. Thus if to a strong man, without previous aural disease or syphilitic taint, a dose of quinine varying from 1 gramme to 8 grammes be given, there will be observed within a few hours marked dulness of hearing, intense roaring in the head and ears, and a sensation of constriction in the head, and in some instances vertigo and pain in one or both ears may be experienced. Bone conduction for the sound of the tuning-fork seems abrogated, as in syphilitic disease of the auditory nerve, and the membrana tympani undergoes a speedy change in appearance, assuming a hazy look, as observed by Kirchner, Schilling, Schwabach, and others. This is due to the congestion and intense hyperæmia of the mucous surface of the drum-membrane which is well known to occur after large doses of quinine.

Salicylate of sodium and salicylic acid do not seem to affect the middle and internal ear so quickly or so extensively as quinine. A gramme every hour for five hours will induce tinnitus aurium and deafness, and perhaps aid in the production of permanent changes in the labyrinth.

If there seems to be in any case an idiosyncrasy rendering the patient especially liable to be affected by quinine and salicylic acid, their peculiar effects upon the auditory apparatus, presumably due to vessel-dilating power, may be overcome by administering the vessel-contracting drug, ergot, shortly after either of the drugs is given.[1] In nine cases given by Schilling in which he combined 1 gramme of quinine with $1\frac{1}{2}$ grammes of ergot or 1 gramme of ergotin, there were no aural symptoms or only very slight ones, while in cases in which this dose of quinine was given without ergot the aural symptoms were intense.

Kirchner[2] has shown that large doses of quinine and also of salicylic acid may cause intense hyperæmia and hæmorrhages in the labyrinth. Thus in a cat to which large doses of quinine had been given a copious extravasation, consisting of white and red corpuscles, was found in the cochlea. In a woman who had taken large doses of salicylic acid for some time after the subsidence of the labyrinth symptoms an exudation was found in the tympanic cavity which necessitated paracentesis of the membrana. Large and long-continued doses of quinine demand, therefore, great caution, lest the hearing be permanently affected

[1] Schilling, *Münchener ärtzl. Intelligenzblatt*, No. 3, 1883.

[2] *Archiv für Ohrenheilkunde*, Bd. xviii. p. 305; *ibid.*, Bd. xx. p. 209.

by the hyperæmia, hæmorrhage, or extravasation which such doses may quickly produce.

Primary Acute Purulent Inflammation of the Labyrinth, resulting in Purulent Meningitis.—Idiopathic, primary, non-traumatic inflammation of the labyrinth has been described and demonstrated by Schwartze.[1] The patient, a woman thirty-two years old, showed as the first marked symptom pain in the right ear, with vertigo and uncertainty of gait. Several weeks previous to this there had been pain in the right temple and brow, with anorexia and insomnia. Gradually the sense of fulness in the ear increased, the hearing became diminished, and vertigo with tinnitus became more distressing. At first headache and vertigo were relieved by rest and elevation of the head in bed. For a month the headache increased and vomiting often occurred. Then the tinnitus and pain in the ear grew worse, sleep was destroyed, and vomiting became more frequent. In four days the patient had become pale and weak; the pulse was 72, temperature 37.8° C.; the gait more uncertain; the pupils normal, but somewhat sluggish to the stimulus of light. The ear and its surroundings were not tender to pressure; the membrana tympani was somewhat hyperæmic; and the hearing had diminished to fifteen centimetres for a watch. The tuning-fork was heard better *per ossa* in the affected ear than in the unaffected one. There then ensued a period of relief for one day, when there was a sudden increase of suffering. The headache became much worse, increasing in the temple, brow, and occiput of the affected side, and the pupils were wide but sluggish; pulse 68, hard and full; and vomiting occurred. In the course of ten or twelve hours sleep ensued, with some jactitations, slight delirium, and a pulse of 92. The next day there was coma with a pulse of 120, and the urine had to be drawn by the catheter. Stertor, trismus, and narrowing of the pupils ensued, preceding death, which occurred without convulsions or paralysis of the extremities.

Post-mortem examination in this case revealed a petrous bone normal externally, no caries or deficiencies of ossification being found in it. The membrana tympani was not perforated. In the cochlea, in the vestibule, and in the semicircular canal there was found a sero-purulent fluid of a milky appearance, which proved on microscopic examination to be due to very fatty pus-cells. The vessels in the semicircular canals, and especially in their ampullæ, were intensely congested and tortuous. At some points in these structures there were small ecchymotic spots. The sacculi in the vestibule were greatly swollen, very red, and infiltrated with pus. No pus was found on the nerve-trunks in the porus acusticus internus, yet there the pia mater was infiltrated with a greenish-yellow pus; on the convexity the gyri were mostly free;

[1] *Archiv für Ohrenheilkunde*, Bd. xiii. pp. 107–112.

on the base of the brain the same purulent infiltration was found. About the right Gasserian ganglion some pus was found between the dura mater and the petrous bone. The surface of the bone was unaltered. The course of the passage of the inflammation of the labyrinth to the cranial cavity was not clearly demonstrable.

Otitis Labyrinthica (Acute Inflammation of the Membranous Labyrinth).—An acute inflammation of the membranous labyrinth, closely resembling the otitis interna of cerebro-spinal meningitis, has been described by Voltolini.[1] From a close study of the cases reported by him it would seem that there is an idiopathic disease of the internal ear closely resembling meningitis in its symptoms, but lacking its fatal termination. The patient, however, is rendered permanently deaf.

There are some points of differential diagnosis worthy of mention —viz. in cerebro-spinal meningitis convalescence is long and herpes labialis is an almost constant symptom, while it rarely appears in otitis labyrinthica. The latter is ushered in by vomiting, which is absent in cerebro-spinal meningitis. In otitis labyrinthica the hearing is quickly and entirely destroyed, while in cerebro-spinal meningitis it is destroyed much less rapidly, and partial audition for some harsh sounds remains in some cases. Treatment is of no avail in cases of otitis labyrinthica.

It is maintained by Gottstein[2] that cases of so-called otitis labyrinthica are in reality the results of cerebro-spinal meningitis, the symptoms of the latter being overlooked, owing to the peculiar course (aural) assumed by the disease. It is assumed that in these cases there is an abortive form of cerebro-spinal meningitis, unproven by post-mortem examination, as otitis labyrinthica never proves fatal.

The strongest argument for the identity of the two diseases is that so-called otitis labyrinthica occurs during epidemics of cerebro-spinal meningitis. Lastly, the symptoms of meningitis always precede the auditory symptoms.

Cerebro-spinal Meningitis: Diseases of the Auditory Nerve and its Terminal Parts.—At the termination of cerebro-spinal meningitis or during convalescence from it the patient is found to be deaf, usually in both ears. There is also in many cases an alteration in gait, the patient assuming a sailor-like walk, and in some instances there is vertigo. The lesion lies in the auditory nerve-trunk and labyrinth, being in fact a neuritis descendens. This is due to a slow encroachment of the inflammation in the meninges upon the labyrinth along the perineural vessels of the auditory nerve. According to Moos, only 1.5 per cent. of cases of cerebro-spinal meningitis observed by him escaped aural lesions.

[1] *Monatsschrift für Ohrenheilkunde*, No. 8, 1872.

[2] *Archiv für Ohrenh.*, xviii. p. 174.

In some instances the mucous membrane of the tympanic cavity is swollen and inflamed. In such a case the resulting deafness does not depend entirely on the lesion in the internal ear.

Congestion of the tympanic cavity often occurs secondarily to suppuration in the labyrinth following inflammatory processes within the cranium, or tympanic congestion may occur as a consequence of meningitis and an extension of the same by means of processes of the dura mater entering the drum-cavity.

It has been shown lately[1] that bilateral purulent infiltrations of the acoustic and facial nerves in the internal auditory canal, sufficient to produce destruction of the fasciculi of the cochlear nerve at the tabula cribrosa, are almost constant symptoms of cerebro-spinal and other forms of meningitis. In cerebro-spinal meningitis the diplo-streptococcus lanceolatus, and in tuberculous meningitis the bacilli of Koch, have been found in the pus surrounding the seventh and eighth nerves in the internal auditory canal; *i. e.* the same micro-organisms causing the meningitis. These same pathogenic organisms have been found in the mucous membrane of the inner wall of the tympanic cavity in the region of the Fallopian canal. This canal is therefore supposed to be the way of transmission of the virus of cerebro-spinal meningitis from the internal auditory canal to the middle ear. The pathogenesis of purulent otitis media, which so often follows the otitis interna of cerebro-spinal meningitis, is thus explained.

Treatment.—It has been proposed by Charcot to treat the dizziness and staggering following cerebro-spinal meningitis by large doses of quinine. He begins with 30 centigrammes of the sulphate of quinine, and gradually increases this until 1 gramme is taken in a day. This course is kept up one month, then stopped for a fortnight, to be resumed for another month. It is claimed that the quinine acts by destroying any remaining functional activity of the auditory nerve or its termini. This theory is not accepted by Moos, a writer of authority on this subject, who claims that quinine acts simply by antagonizing the inflammation. In those cases in which the hearing is not entirely destroyed the application of the constant electric current to the ears offers some hope of benefit if carried out soon after convalescence from the original disease; but if delayed many weeks there is little encouragement to make the application.

Syphilitic Disease of the Internal Ear.—Sudden, total, and permanent loss of hearing has been considered characteristic of disease of the internal ear induced by syphilis. In most instances of loss of hearing, presumably from syphilis, there is a well-authenticated history of acquired or hereditary syphilis. In many cases the lesion lies in the middle ear, but the aural affection is mistaken for one of the internal

[1] G. Gradenigo of Turin, *Annales des Maladies de l'Oreille*, Sept., 1890.

or percipient portion of the ear. Those cases of reported cures of syphilitic deafness said to be due to a specific affection of the cochlea were probably cases of syphilitic disease in the middle ear, and hence more or less remediable.

Iodide of potassium and bichloride of mercury in proper doses will benefit deafness from syphilitic tympanic disease, but when the lesion is in the internal ear and auditory nerve it is incurable.

Concussion of the Internal Ear.—Concussion of the internal ear may be the result of a fall, a blow upon the ear or head, or of an explosion or discharge of firearms near the ear. The symptoms are instant tinnitus and a feeling of fulness, with more or less deafness of a profound character in one or both ears. Sometimes, after concussion of the labyrinth, there may be a peculiar subjective echo-like termination of words spoken by the patient and others.[1] In some instances of concussion of the labyrinth there is a temporary paralysis of the sense of smell, as in a case reported by the writer.[2] In some cases there may be at once loud subjective noises in the head, headache, vertigo, insomnia, and great nervous excitement. In the course of two or three days there may be considerable feverish disturbance of the general system. In most instances there is no evidence of any lesion in the external or middle ear. Sometimes, however, there are slight hæmorrhages from the meatus immediately after the concussion, its force having been partially spent upon the tissues of the fundus of the auditory canal and membrana flaccida. The deafness may affect both ears at first, one of which may recover; or if only one ear is affected at the outset, a partial recovery in it may ensue. If, however, the deafness is profound from the outset, the chance of recovery of the hearing is slight.

TREATMENT.—The treatment should consist in the administration of iodide of potassium, bromides of potassium and sodium, ergot, and in counter-irritations near the affected ear.

Histological Changes in the Labyrinth in Typhoid Fever, Scarlet Fever, and Variola.—The inflammatory process in the labyrinth in *typhoid fever* must be regarded in some instances as a specific lymphatic formation peculiar to typhoid, like that occurring in other organs in this disease. In some instances it seems to be an extension of inflammation from the tympanic cavity.

In scarlet fever there may occur ambilateral inflammation in the labyrinth. There occurs a rich infiltration of small cells, as well as of pus-cells, diffused over the membranous sacculi, ampullæ, and semicircular canals. This condition of the labyrinth is considered an ex-

[1] Blau, *Archiv für Ohrenheilkunde*, Bd. xv. p. 225; G. Brunner, *Archives of Otology*, vol. ix. p. 339.

[2] *Treatise on the Ear*, Phila., 1877.

planation of all of those cases of great hardness of hearing or absolute deafness after scarlet fever in which an analysis of other clinical symptoms excludes the supposition that a concomitant cerebral affection has caused the destruction of hearing.[1]

In *variola* a purulent inflammation of the labyrinth may be found independent of a purulent process in the drum-cavity.[2]

It is claimed by Moos and O. Wolf that the deafness resulting from labyrinth disease induced by scarlatina can be benefited by hypodermic injections of pilocarpine, as suggested by Politzer: 10 drops at first, then 20 drops at a time, of a solution of muriate of pilocarpine, $\frac{2}{100}$ gramme in 2 grammes of distilled water, were injected into a child seven years old with apparent benefit.

Pilocarpine has been used with asserted advantage by Lucæ[3] in several cases of disease of the middle ear (infiltration and exudation). In a case of acute disease of the internal ear in a woman suffering from emansio mensium and determination of blood to the head thirteen subcutaneous injections of pilocarpine were given. Improvement was noted after the fifth injection. The first injection contained 0.005 gramme, which not being endured, the next injection contained 0.0025 gramme of pilocarpine. In a second instance chronic exudation in the labyrinth was greatly improved by hypodermic injections of pilocarpine. In twenty-three days fourteen injections of pilocarpine, each 0.01 gramme, were given. The hearing was improved and the tinnitus aurium diminished by the medication. In two cases of aural vertigo (so-called Ménière's form) Lucæ obtained some relief from a course of hypodermic injections of pilocarpine. In one case during two months thirty-two subcutaneous injections of pilocarpine, 0.01 gramme each, were administered. In another case, which was ambilateral, twenty-six pilocarpine injections, 0.01 gramme each, were administered in the course of six weeks without beneficial effect.

Internal Ear affected by Mumps.—That the nervous apparatus of the internal ear is sometimes suddenly and permanently injured by the poison of mumps has been recognized by Toynbee and Hinton and by late writers. The process is probably a metastatic one.

The symptoms consist in simultaneous tinnitus aurium, vertigo, and deafness. The two former symptoms disappear sooner or later, but the deafness remains. There may be nausea, vomiting, and altered gait in addition to the above. These symptoms may appear as early as the third or fourth day and as late as the fifteenth. There are usually no symptoms in the external or middle ear to account for these peculiar phenomena. But their sudden occurrence during mumps will enable

[1] Moos, *Archives of Oph. and Otology*, vol. v. [2] Moos, *loc. cit.*

[3] *Archiv für Ohrenheilkunde*, Bd. xxi.

the physician to make a diagnosis of the true nature of the ear disease. Sometimes the pain in the ear and head is great.

No treatment has shown itself capable of either preventing the destruction of hearing when the ear is first threatened or of curing the deafness after it has manifested itself.

The Nerve Lesions in Deaf-dumbness.—Congenital deafness is sometimes due to an early periostitis in the petrous bones. This brings about a sclerosis in the substance of the bones, ankylosis of the ossicles, partial hyperostosis of the tympanic cavity, and closure of the round window. A colloid substance may be found in such cases in the labyrinth. Often there is no trace of semicircular canals, ampullæ, or cochlea. The auditory nerves may be atrophic and contain concretions of phosphate of lime. In such cases only the auditory vesicle is arrested in development.

In acquired deaf-dumbness the only lesion may be in the cochlea, all other parts being normal. Both scalæ may be invaded by new-formed bone-tissues, and the nerve-fibres may be wanting in the lamina spiralis ossea. In other cases numerous colloid globules and molecular detritus have been found in the connective tissue of the utriculus, the semicircular canals, and the ampullæ.

Sarcoma of the Auditory Nerve.—The earliest manifestations of this disease of the auditory nerve may come on after taking severe cold from exposure. They may consist in anæsthesia of the face and of the nasal mucous membrane, with hypersecretion and bleeding of the nose, anæsthesia of the oral mucous membrane, defective vision, with increased secretion of tears and ptosis on the side of the affected auditory nerve, and with moderate headache and vertigo. The hearing and taste soon become diminished, and in some cases the sense of smell is lessened. In the course of five or six months, the anæsthetic symptoms remaining unaltered, the vision may further diminish, and there may ensue diplopia, narrowing of the pupil, anæsthesia of the cornea, convergent strabismus, nystagmus, twitching of the mimic muscles of the face, tonic spasm of the frontalis, intermittent vertigo, headache, unsteady gait, and ataxic movements in the arm of the side corresponding to the seat of the tumor.[1] In some instances sarcoma of the auditory nerve may be attended by great pain in the ear for many months before death. This is due to the extension of the disease outward into the middle, and even into the external, ear.[2] The mastoid process may become very tender and somewhat swollen from external engorgement when sclerosis of the walls and cells of the mastoid and narrowing of the antrum have been induced by the disease.

In a case of sarcoma of both auditory nerves observed by Dr.

[1] Moos, *Archives of Oph. and Otol.*, vol. iv.

[2] Burckhardt-Merian, *Archiv für Ohrenheilkunde*, Bd. xiii. pp. 11–18.

Morris Longstreth and myself[1] a woman forty-five years old had always been well until within fourteen months of her death, when she took a severe cold in her head. She also began to have pain in her forehead and vertex. Nine months later she began to grow deaf very rapidly; tinnitus aurium superseded, with unsteadiness of gait, pain in the limbs, impairment of sensation in the legs, nearly constant vertigo, and occasional nausea. There had never been before this any loss of power in the limbs nor muscular trembling. In thirteen months from the first failure in health it was noted that in walking there was a tendency to fall toward the right, and it was found that she had fallen several times without loss of consciousness. Tinnitus aurium continued and deafness became profound. There was no history or suspicion of syphilis. At last, in the course of a year, there were increased headache, vertigo, falling without the ability to rise, general loss of power to assist herself, and finally confinement to bed. Then there ensued loss of power over legs, failure of intellect, and difficulty of swallowing. The muscles of the eyeball prolapsed, pulse and respiration increased in frequency, cyanosis of the face appeared, the urine was passed involuntarily, and the sensibility of the extremities became impaired. This was soon followed by unconsciousness, with a temperature of 106° F. a few hours before death.

Sarcoma of the auditory nerve may occur in young subjects, as in the case of a girl seventeen years old.[2] In this instance there was diminished mental activity for four years before death, the first symptoms being in the patient's thirteenth year. In two years convergent squint began to replace a divergent squint which the child had had since her sixth year. There was no paralysis of the external recti muscles. Movements became difficult and her words dragged. Two years before death unsteadiness of gait was observed. Deafness in the left ear was observed a year before death. There was marked loss of muscular co-ordination in walking, but the patient could sew well. At this time disease at the base of the brain, probably a tumor at the base of the left hemisphere, was diagnosed. There now rapidly ensued great weakness, difficulty in walking and standing, and powerlessness of the right side. Gradually stupor, coma, difficulty of speech, and clouded intellect supervened, and in four weeks from the time of the diagnosis death occurred. In the last five days of life there was total inability to move the right arm or leg, but no cramps or convulsions took place.

Adenoma of the petrous bone, involving the internal, middle, and even the external, ear, has been described by Sexton.[2] The patient, a sailor, succumbed to the disease at the age of forty-five, after presenting

[1] Burnett's *Treatise on the Ear*, 2d ed., pp. 558–562.

[2] Dr. George T. Stevens, *Archives of Otology*, vol. viii. p. 171.

[3] *N. Y. Medical Journal*, Dec. 13, 1884.

a remarkable train of nervous symptoms from his fourteenth till his twenty-fourth year, when the strictly aural symptoms set in. The latter continued with varying intensity for twenty years. It was supposed that in this case misplaced or superabundant embryonic cells could account for the origin of the tumor.

Hughes : 17 Mar. 94.

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With the close of the chapter just referred to (*Vertebral Artery*, Ligature of the, Heath's "Dictionary of Practical Surgery," vol. II., page 786), my interest in epilepsy did not cease. Indeed, at the time the article referred to was written, most of the investigations and operations now about to be described were complete, and time alone was wanting to realise their value. Sufficient time has now elapsed to test results, and these results are so encouraging and so interesting that I do not think I should withhold them any longer from the profession.

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